Proceedings of the Second Workshop on

Rail-Highway

Compte rendu du Deuxième atelier sur

passages à niveau

TP 13536

November 2000
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Proceedings of the Second Workshop on Rail-Highway Grade Crossing Research

Montreal, Quebec

15 November 2000

Compte rendu du Deuxième atelier sur la recherche sur les passages à niveau

Montréal, Québec

15 novembre 2000

The contents of these proceedings reflect the views of the speakers and not necessarily those of the workshop sponsors.

The presentations appear in the language in which they were delivered. Summaries or abstracts are provided in both official languages.

The *Direction 2006* Research Committee thanks all those who helped to make the workshop a success.

Les opinions et les vues exprimées dans ce compte rendu sont celles des conférenciers et ne reflètent pas nécessairement celles des organisateurs de l'atelier.

Les exposés sont publiés dans la langue qu'ils ont été présentés. Ils sont accompagnés de sommaires ou de résumés rédigés dans les deux langues officielles.

Le Comité sur la recherche de *Direction 2006* tient à remercier toutes les personnes qui ont contribué à faire de l'atelier un succès.

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16. Abstract

This report contains the presentations given at the Workshop on Rail-Highway Grade Crossing Research held in Montreal, Quebec, 15 November 2000. The workshop was organized by members of the *Direction 2006* Research Committee. The presentations focus on research and development designed to improve rail-highway grade crossing safety. Summaries or abstracts are provided in both official languages.

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16. Résumé

Ce rapport rend compte des présentations faites au Deuxième atelier sur la recherche sur les passages à niveau qui a eu lieu à Montréal, Québec, le 15 novembre 2000. Cet atelier avait été organisé par les membres du Comité sur la recherche de *Direction 2006*. Les exposés portent sur la recherche et développement en cours pour améliorer la sécurité aux passages à niveau. Chacun fait l'objet d'un sommaire ou d'un résumé en anglais et en français.

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Introduction

William F. Johnson welcomed participants on behalf of Transport Canada and the Transportation Development Centre, as well as *Direction 2006*.

Dr. Johnson congratulated the workshop organizers on their successful efforts and wished participants every success in their deliberations. He noted the workshop's full agenda and said that he was looking forward to participating in the sessions and to learning more about grade crossing research.

Bob Nash of Canadian Pacific Railways also welcomed participants. He stressed the importance of the workshop and of stakeholder participation to the continuing success of the Grade Crossing Research Program.

Mr. Nash is a member of the Research Committee of *Direction 2006,* a cooperative federal initiative to halve rail-highway grade crossing and trespassing accidents by the year 2006.

He noted that the workshop objectives were:

- To provide updates on:
    - *Direction 2006* Executive Committee activities
    - Research KRA Steering Committee progress
    - Canadian and U.S. grade crossing research projects
    - Canadian and U.S. directions in grade crossing research

- To solicit feedback from participants on issues, projects, priorities, and plans

---

Au nom de Transports Canada, du Centre de développement des transports et de *Direction 2006*, William F. Johnson souhaite la bienvenue aux participants.

M. Johnson félicite les organisateurs de l'atelier pour leurs fructueux efforts, et souhaite à tous une journée de discussions des plus profitables. Il fait remarquer que l'ordre du jour de l'atelier est chargé, et qu'il se réjouit de la chance qui lui est donnée de participer aux séances de travail et d'approfondir ses connaissances sur la recherche sur les passages à niveau.

Bob Nash, de Canadien Pacifique Limitée, souhaite également la bienvenue à tous les participants. Il souligne l'importance de l'atelier et de la participation de tous les intervenants pour maintenir le Programme de recherche sur les passages à niveau sur la voie du succès.

M. Nash est membre du Comité sur la recherche de *Direction 2006*, un programme de coopération lancé par le gouvernement fédéral dans le but de diminuer de moitié le nombre d'accidents aux passages à niveau et d'intrusions sur les emprises ferroviaires d'ici 2006.

Il fait état des objectifs de l'atelier, qui consistaient à :

- Faire le point sur :
  - les activités du Comité exécutif de *Direction 2006*
  - les travaux du Comité directeur des secteurs stratégiques de recherche
  - les projets de recherche sur les passages à niveau au Canada et aux États-Unis
  - les orientations de la recherche sur les passages à niveau au Canada et aux États-Unis

- Obtenir des suggestions et commentaires des participants (sujets de recherche, projets, priorités, plans)

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Direction 2006 Executive Committee Update

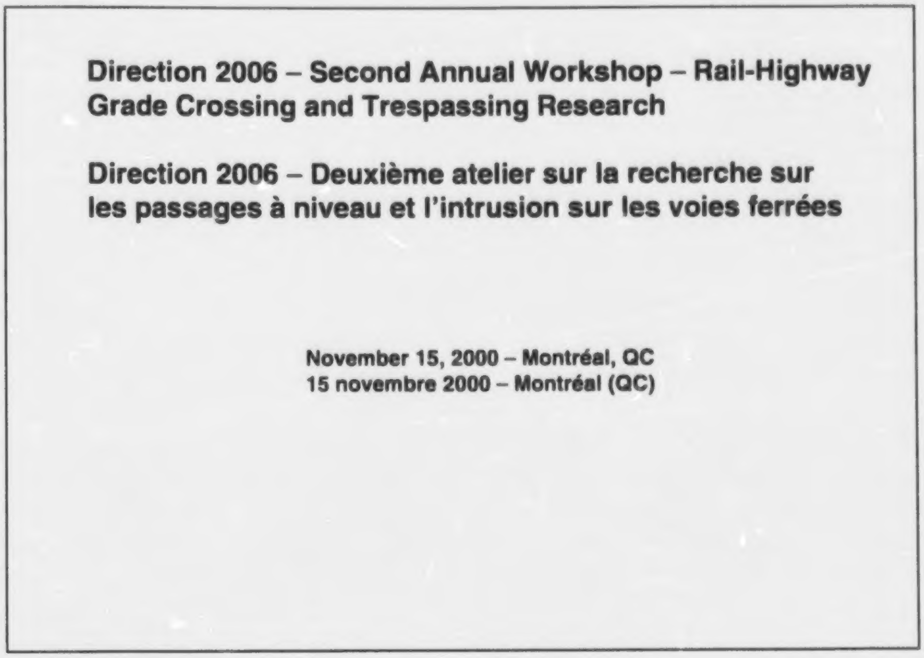
G. Drouin
Transport Canada/Transports Canada
Rail Safety/Sécurité ferroviaire
Ottawa, Ontario

ABSTRACT

This presentation describes *Direction 2006,* a public-private partnership aimed at halving the number of rail-highway grade crossing collisions and trespassing incidents on railway property by the year 2006. Partners include provincial and municipal governments, railway companies and their unions, law enforcement agencies, and other safety organizations. With the work of the seven key result areas of education, enforcement, engineering, research, legislative, resource, and communications, the *Direction 2006* partners hope to see continued success leading to achievement of the program goal.

RÉSUMÉ

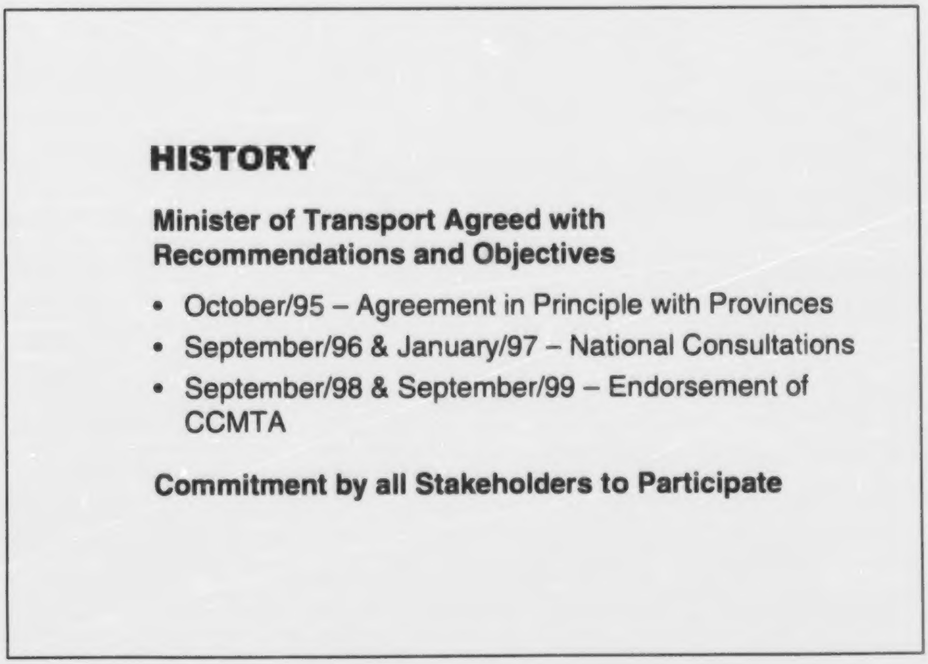
Il s'agit d'une description de *Direction 2006*, un partenariat entre les secteurs public et privé, qui vise à diminuer de moitié le nombre d'accidents aux passages à niveau et d'intrusions sur les emprises ferroviaires d'ici 2006. Parmi les partenaires de *Direction 2006* figurent les gouvernements provinciaux et municipaux, les sociétés ferroviaires et leurs syndicats, les organismes d'application de la loi, ainsi que d'autres organismes de sécurité. Partageant leurs travaux entre sept secteurs stratégiques d'intervention, soit l'éducation, l'application de la loi, l'ingénierie, la recherche, le cadre bureaucratique et législatif, les ressources et les communications, les partenaires de *Direction 2006* espèrent voir se multiplier les succès qui feront de l'objectif du programme une réalité.



Direction 2006 – Second Annual Workshop – Rail-Highway Grade Crossing and Trespassing Research

Direction 2006 – Deuxième atelier sur la recherche sur les passages à niveau et l'intrusion sur les voies ferrées

November 15, 2000 – Montréal, QC
15 novembre 2000 – Montréal (QC)

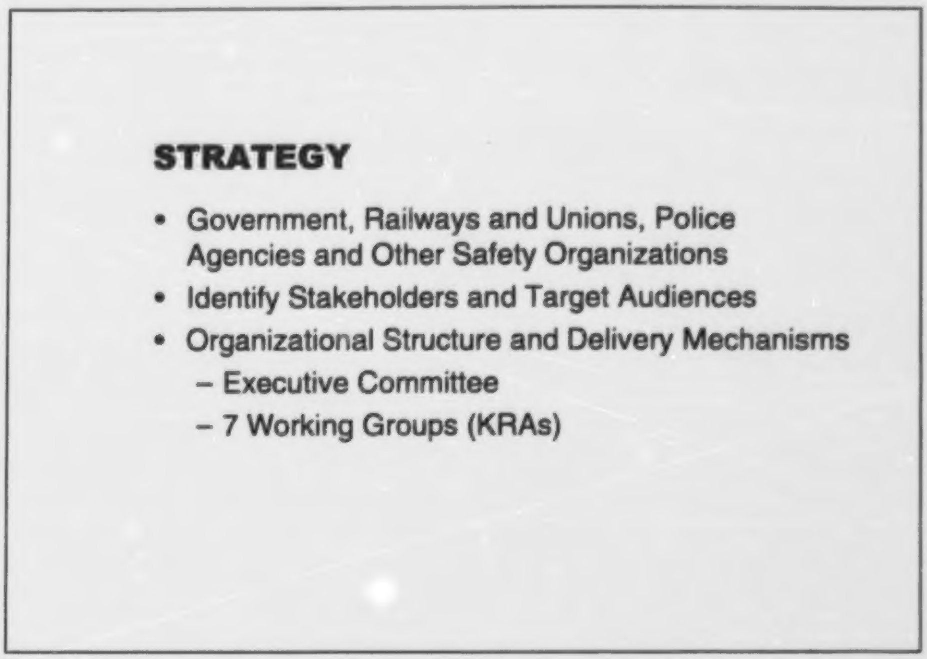


HISTORY

Minister of Transport Agreed with Recommendations and Objectives

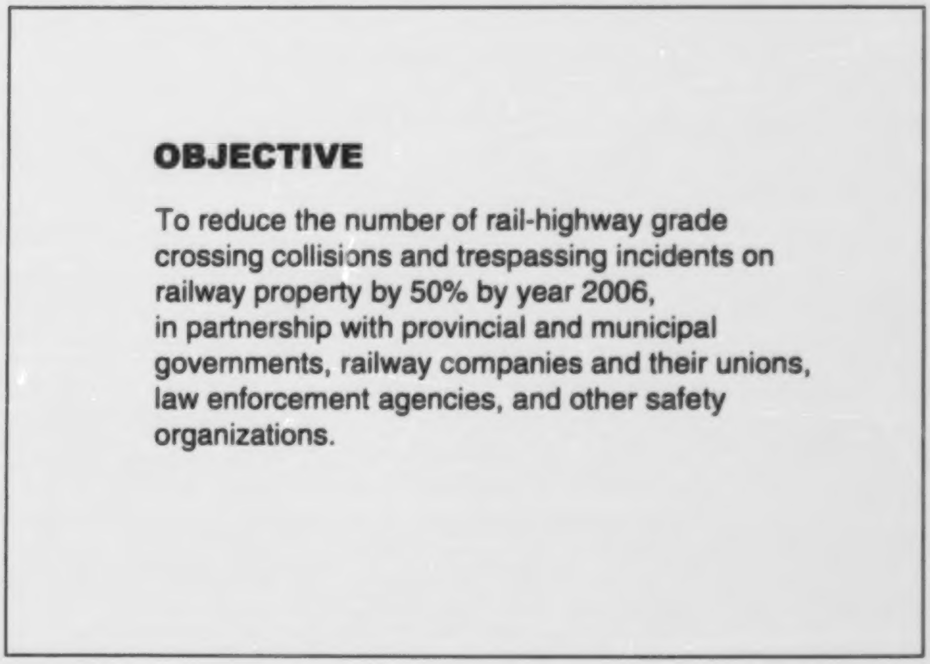
- October/95 – Agreement in Principle with Provinces
- September/96 & January/97 – National Consultations
- September/98 & September/99 – Endorsement of CCMTA

Commitment by all Stakeholders to Participate



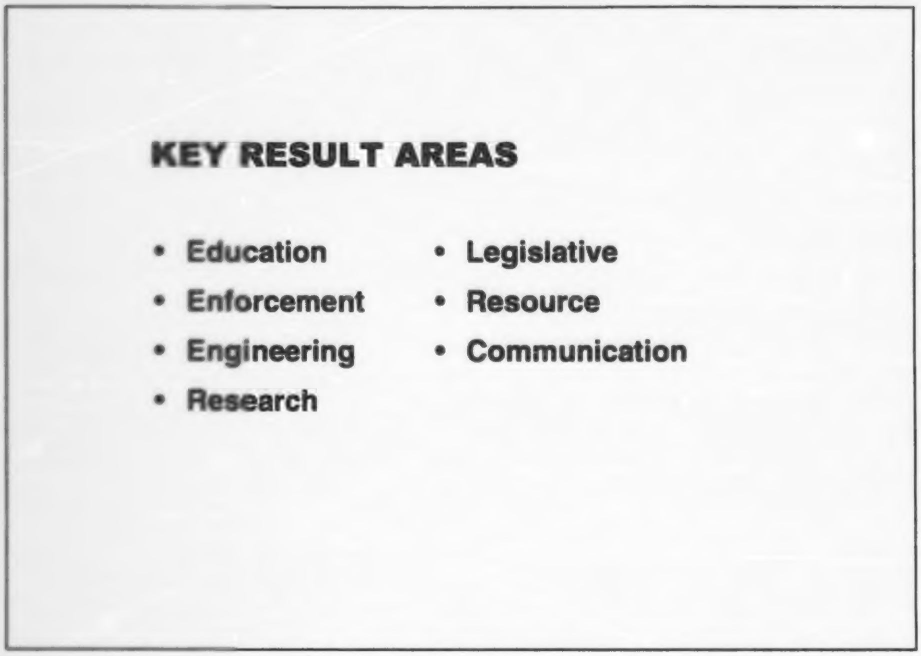
STRATEGY

- Government, Railways and Unions, Police Agencies and Other Safety Organizations
- Identify Stakeholders and Target Audiences
- Organizational Structure and Delivery Mechanisms
  - Executive Committee
  - 7 Working Groups (KRAs)



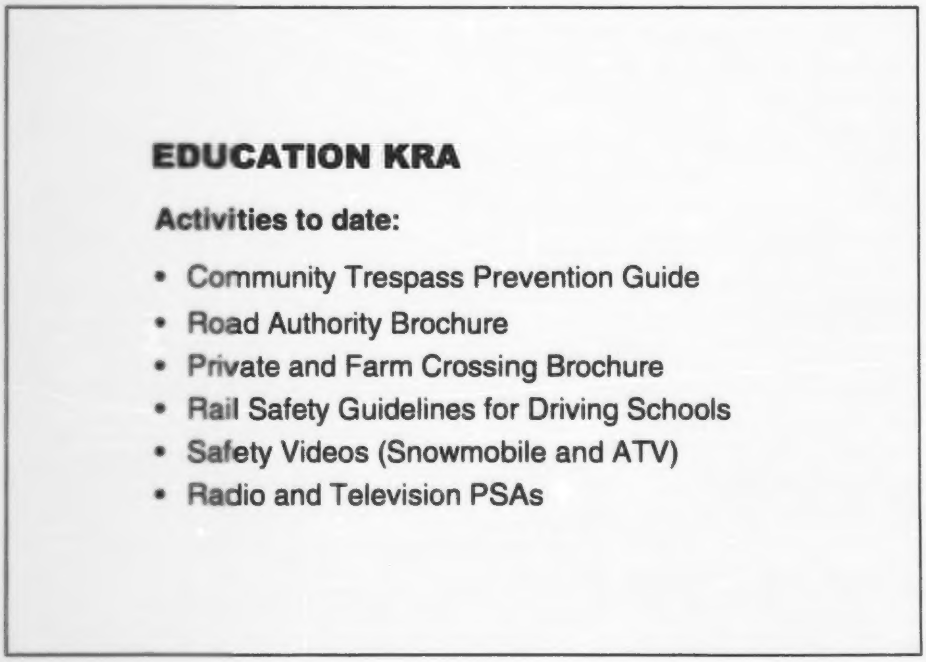
OBJECTIVE

To reduce the number of rail-highway grade crossing collisions and trespassing incidents on railway property by 50% by year 2006,
in partnership with provincial and municipal governments, railway companies and their unions, law enforcement agencies, and other safety organizations.



KEY RESULT AREAS

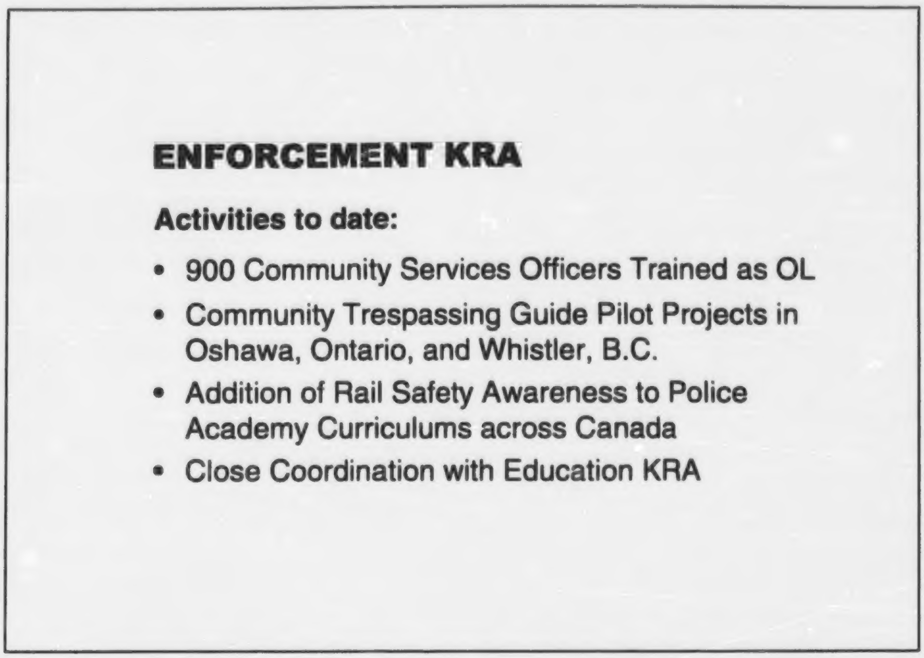
- Education
- Enforcement
- Engineering
- Research
- Legislative
- Resource
- Communication



EDUCATION KRA

Activities to date:

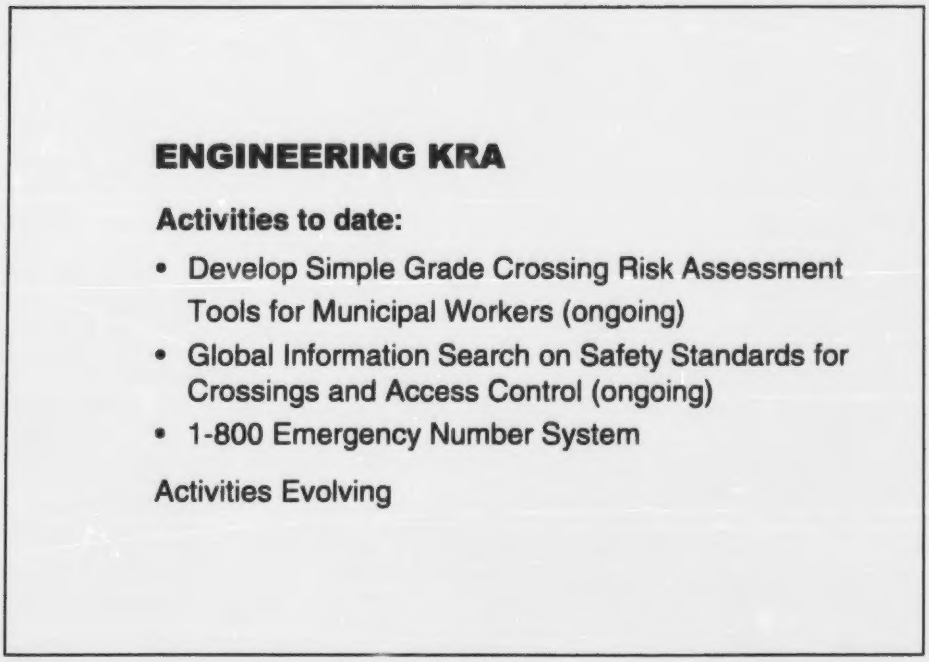
- Community Trespass Prevention Guide
- Road Authority Brochure
- Private and Farm Crossing Brochure
- Rail Safety Guidelines for Driving Schools
- Safety Videos (Snowmobile and ATV)
- Radio and Television PSAs



ENFORCEMENT KRA

Activities to date:

- 900 Community Services Officers Trained as OL
- Community Trespassing Guide Pilot Projects in Oshawa, Ontario, and Whistler, B.C.
- Addition of Rail Safety Awareness to Police Academy Curriculums across Canada
- Close Coordination with Education KRA



ENGINEERING KRA

Activities to date:

- Develop Simple Grade Crossing Risk Assessment Tools for Municipal Workers (ongoing)
- Global Information Search on Safety Standards for Crossings and Access Control (ongoing)
- 1-800 Emergency Number System

Activities Evolving

RESEARCH KRA

Activities to date:

- $1.4 Million Research Program by TDC, funded by TC, Railways, Provinces and FCM:
  - Accident Causal Analysis and Remedial Actions
  - Second Train Warning Systems
  - Locomotive Horn Study for High Speed Trains

RESEARCH KRA (continued)

Activities to date:

- Enhanced Database for Crossing Incidents
- Alternative "Efficient/Low-Cost" Equipment & Systems
- Planned Workshop on Research Initiatives – Winter 99/00

LEGISLATIVE KRA

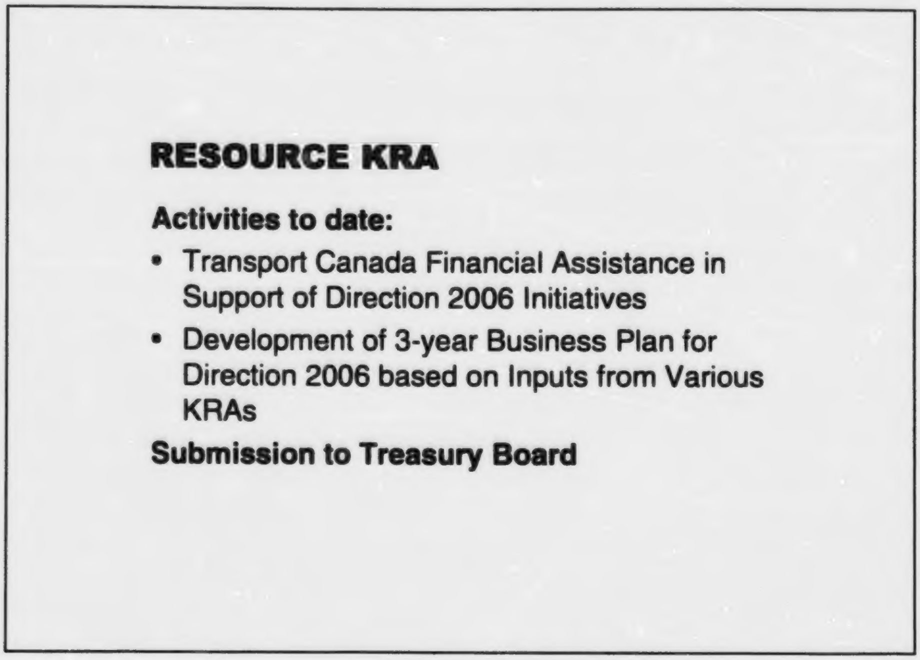
Activities to date:

- Developing a User Guide on Crossing Elimination/Consolidation
- Developing a "Set-Back Policy", in Collaboration with Association of Urban Planners, for Land Development adjoining Railway Right-of-Way
- "Provincial Harmonization", Initiatives to assist Provincial Jurisdictions with Crossing and Trespassing Safety Issues

COMMUNICATION KRA

Activities to date:

- Development of D2006 Logo and Launch
- D2006 Web Site and Hot Links
- Public Opinion Benchmarking Polling and Focus Groups
- D2006 Briefing Materials and Radio/TV PSAs
- 3-year Communications Plan Established

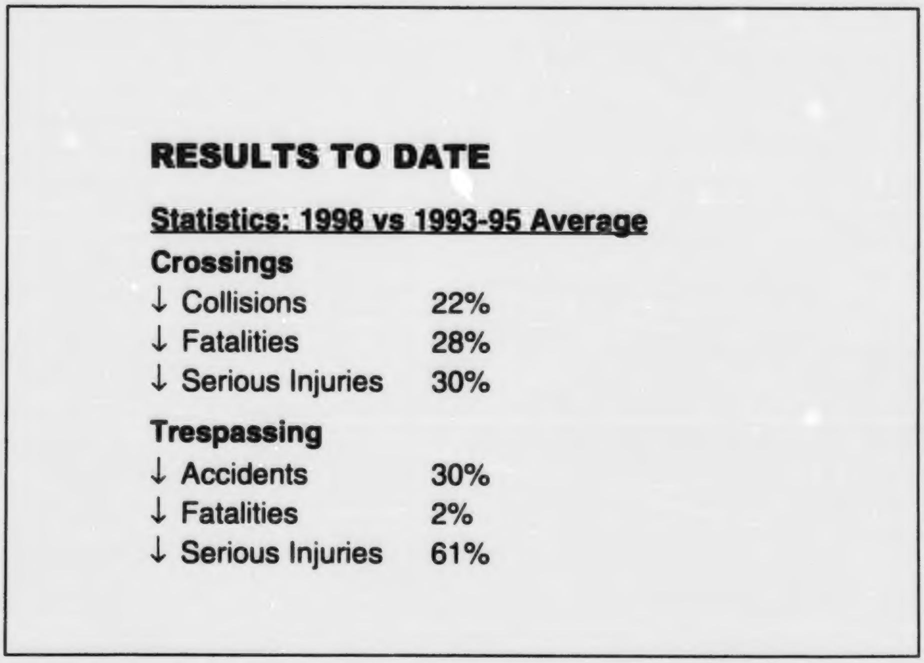


RESOURCE KRA

Activities to date:

- Transport Canada Financial Assistance in Support of Direction 2006 Initiatives
- Development of 3-year Business Plan for Direction 2006 based on Inputs from Various KRAs

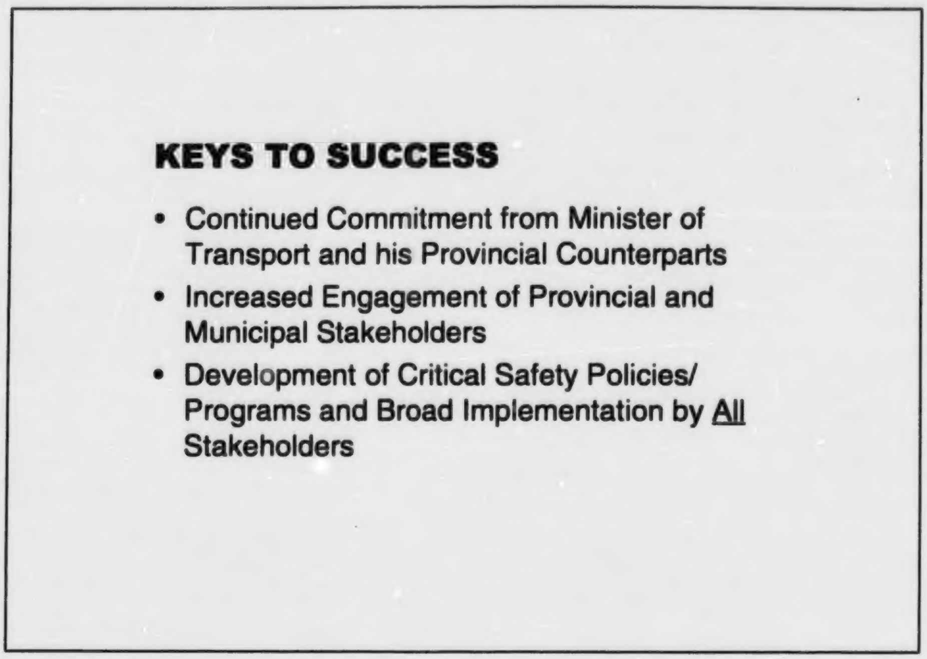
Submission to Treasury Board



RESULTS TO DATE

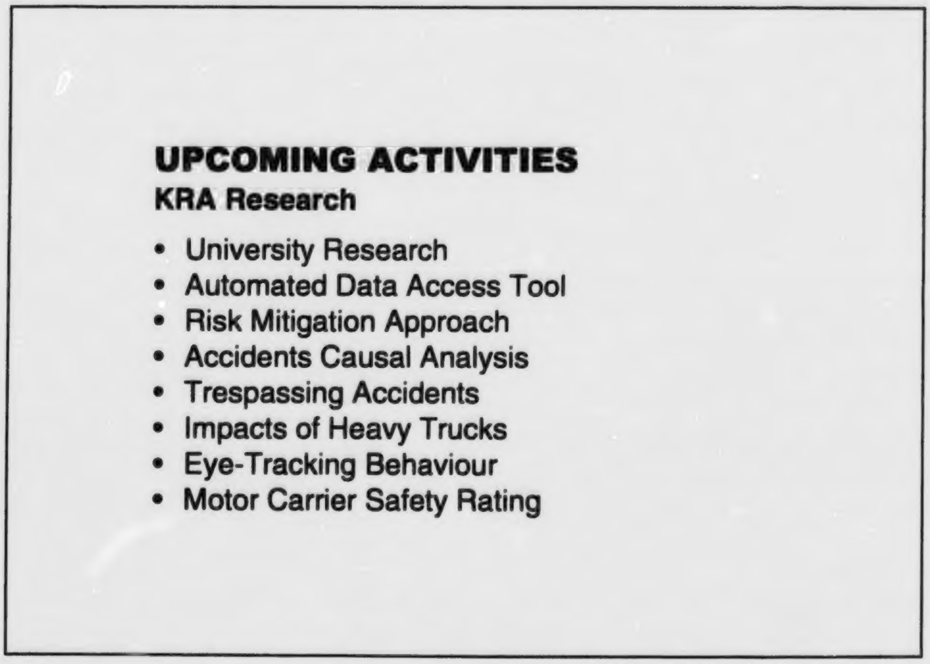
Statistics: 1998 vs 1993-95 Average

Crossings	
↓ Collisions	22%
↓ Fatalities	28%
↓ Serious Injuries	30%
Trespassing	
↓ Accidents	30%
↓ Fatalities	2%
↓ Serious Injuries	61%



KEYS TO SUCCESS

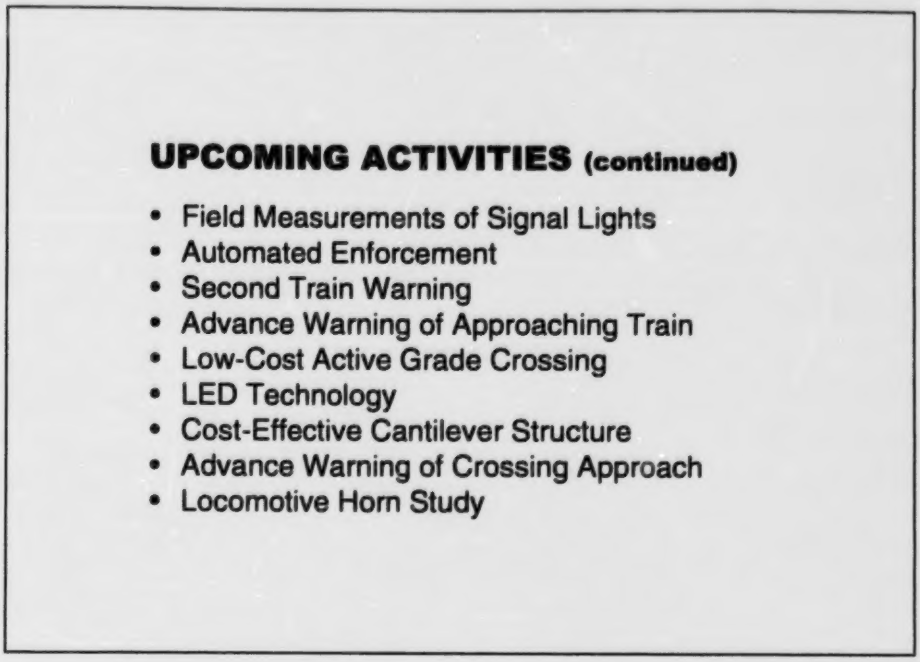
- Continued Commitment from Minister of Transport and his Provincial Counterparts
- Increased Engagement of Provincial and Municipal Stakeholders
- Development of Critical Safety Policies/ Programs and Broad Implementation by All Stakeholders



UPCOMING ACTIVITIES

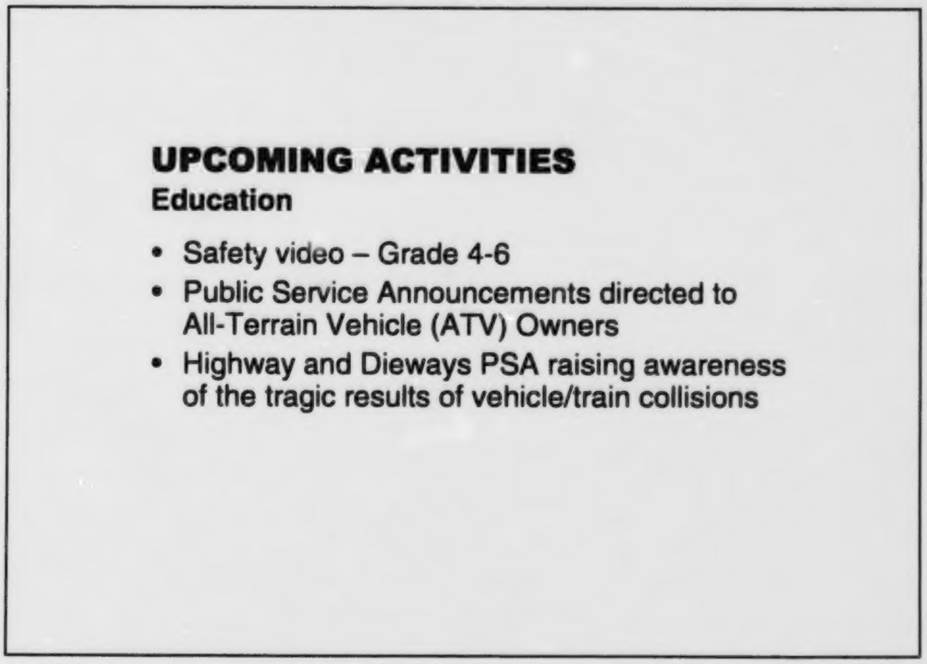
KRA Research

- University Research
- Automated Data Access Tool
- Risk Mitigation Approach
- Accidents Causal Analysis
- Trespassing Accidents
- Impacts of Heavy Trucks
- Eye-Tracking Behaviour
- Motor Carrier Safety Rating



UPCOMING ACTIVITIES (continued)

- Field Measurements of Signal Lights
- Automated Enforcement
- Second Train Warning
- Advance Warning of Approaching Train
- Low-Cost Active Grade Crossing
- LED Technology
- Cost-Effective Cantilever Structure
- Advance Warning of Crossing Approach
- Locomotive Horn Study



UPCOMING ACTIVITIES

Education

- Safety video – Grade 4-6
- Public Service Announcements directed to All-Terrain Vehicle (ATV) Owners
- Highway and Dieways PSA raising awareness of the tragic results of vehicle/train collisions

UPCOMING ACTIVITIES (continued)

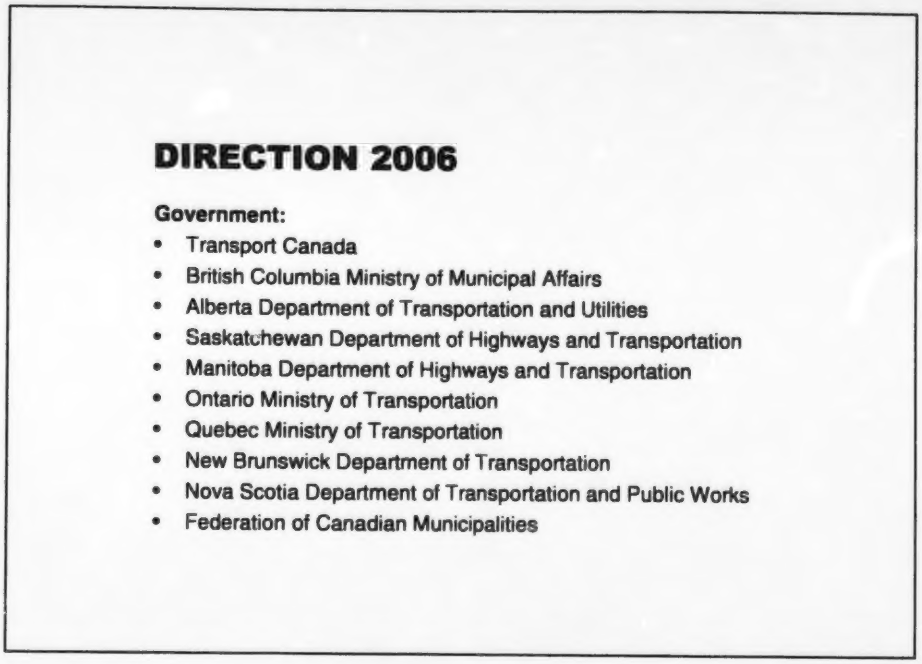
Education

- Multi-Media Rail Safety Information Game for Web Site
- Development of Billboard Campaign with Focus on High Risk Areas
- Development of Rail Safety Material designed for Aboriginal Population

UPCOMING ACTIVITIES

Enforcement

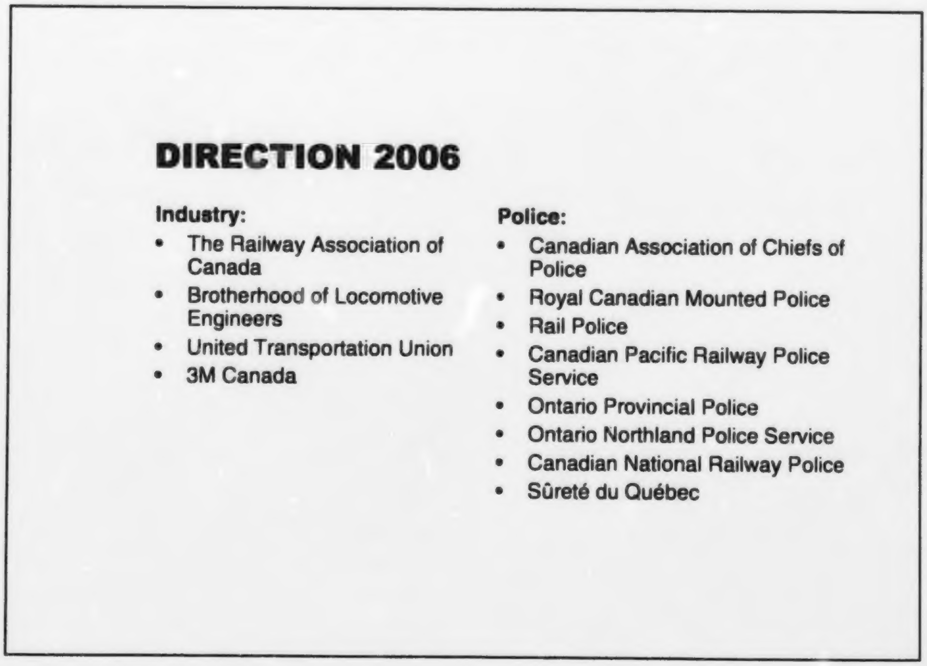
- Implementation of the Community Trespassing Prevention Guide in High-Risk Areas across Canada
- Development of Rail Safety Information for New Recruits in Police Academies across Canada



DIRECTION 2006

Government:

- Transport Canada
- British Columbia Ministry of Municipal Affairs
- Alberta Department of Transportation and Utilities
- Saskatchewan Department of Highways and Transportation
- Manitoba Department of Highways and Transportation
- Ontario Ministry of Transportation
- Quebec Ministry of Transportation
- New Brunswick Department of Transportation
- Nova Scotia Department of Transportation and Public Works
- Federation of Canadian Municipalities



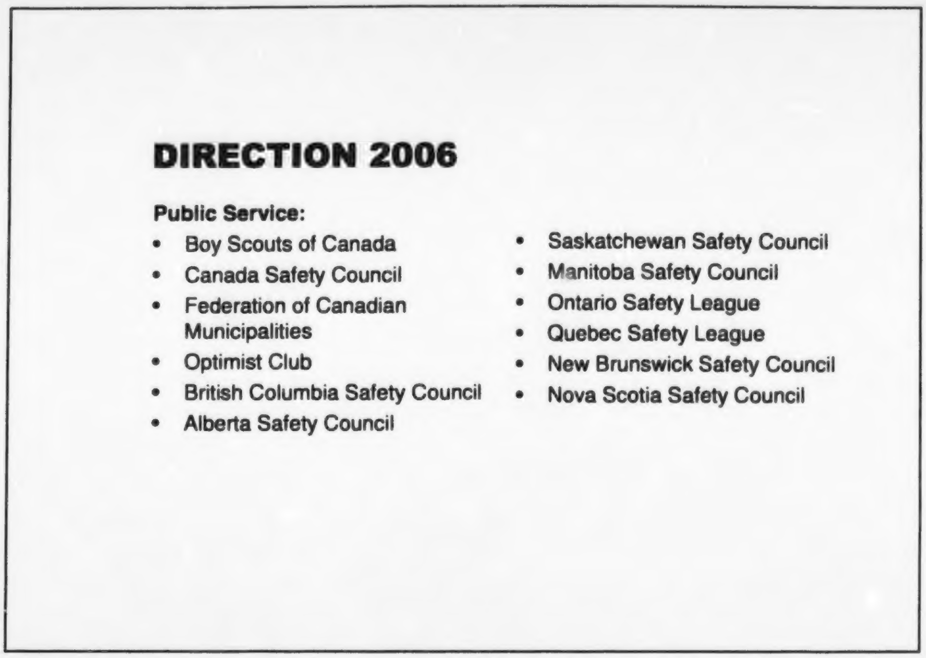
DIRECTION 2006

Industry:

- The Railway Association of Canada
- Brotherhood of Locomotive Engineers
- United Transportation Union
- 3M Canada

Police:

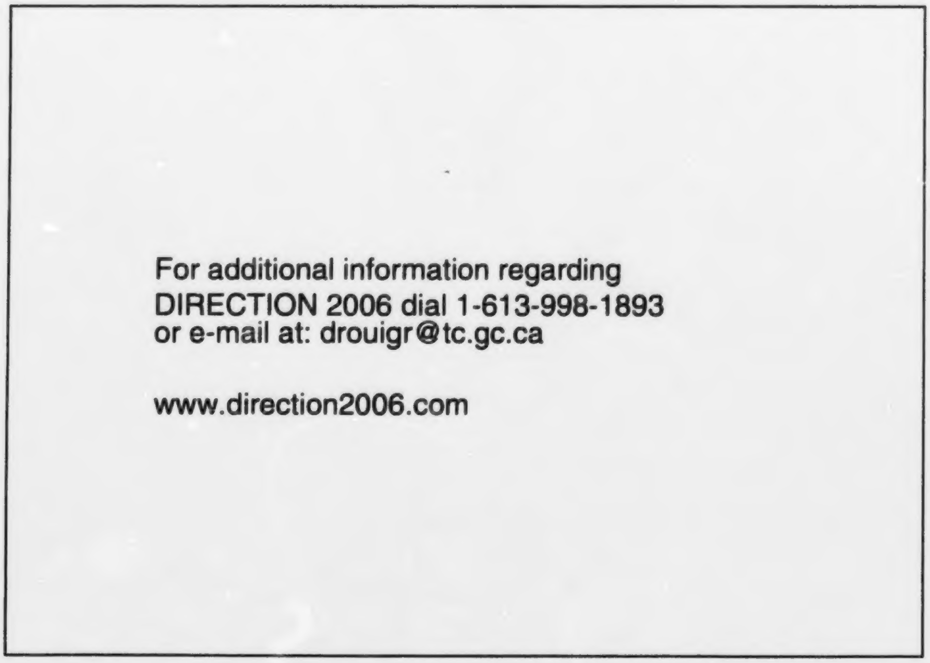
- Canadian Association of Chiefs of Police
- Royal Canadian Mounted Police
- Rail Police
- Canadian Pacific Railway Police Service
- Ontario Provincial Police
- Ontario Northland Police Service
- Canadian National Railway Police
- Sûreté du Québec



DIRECTION 2006

Public Service:

- Boy Scouts of Canada
- Canada Safety Council
- Federation of Canadian Municipalities
- Optimist Club
- British Columbia Safety Council
- Alberta Safety Council
- Saskatchewan Safety Council
- Manitoba Safety Council
- Ontario Safety League
- Quebec Safety League
- New Brunswick Safety Council
- Nova Scotia Safety Council



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www.direction2006.com

Research KRA Steering Committee Report

Alvan Tom
Canadian National Railways/Canadien National
Montreal, Quebec

ABSTRACT

This presentation describes the research KRA's position as one of seven under the *Direction 2006* umbrella. It lists the Research KRA Steering Committee's objectives, the stakeholders involved, and the research team members. It goes on to outline the achievements to date, the first round of research projects, and proposed projects.

RÉSUMÉ

Cette présentation expose la situation de la Recherche en tant que l'un des sept secteurs stratégiques d'intervention regroupés sous le chapeau de *Direction 2006*. Elle présente les objectifs du Comité directeur du secteur de la Recherche, les intervenants concernés, et les membres de l'équipe de la recherche. Elle donne un aperçu des réalisations à ce jour, du premier appel de projets de recherche, et des projets proposés.

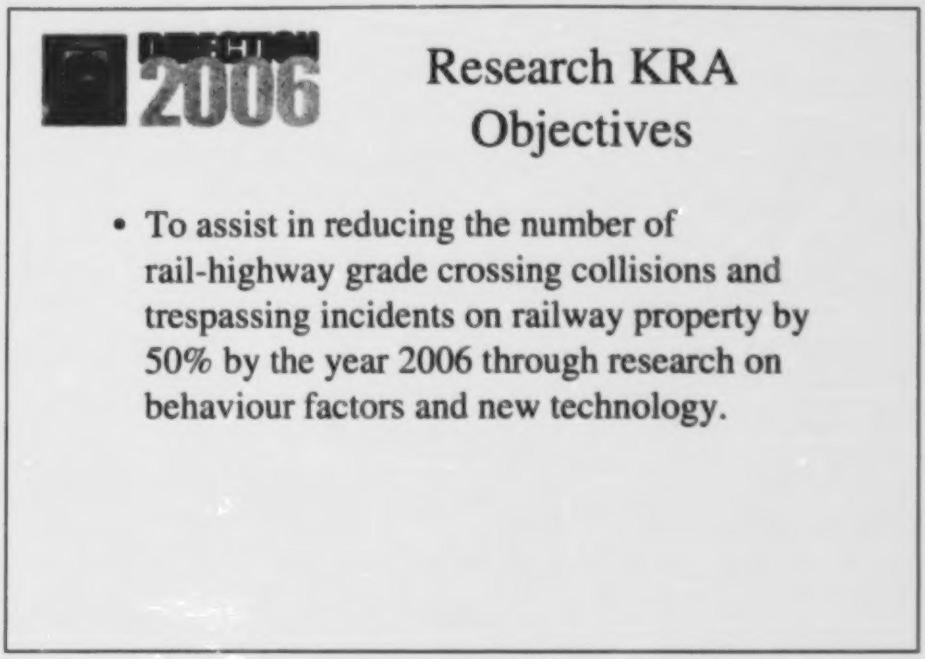
Research KRA Steering Committee Report

Workshop on Rail-Highway
Grade Crossing Research
November 15, 2000
Montreal

DIRECTION 2006
KEY RESULT AREAS

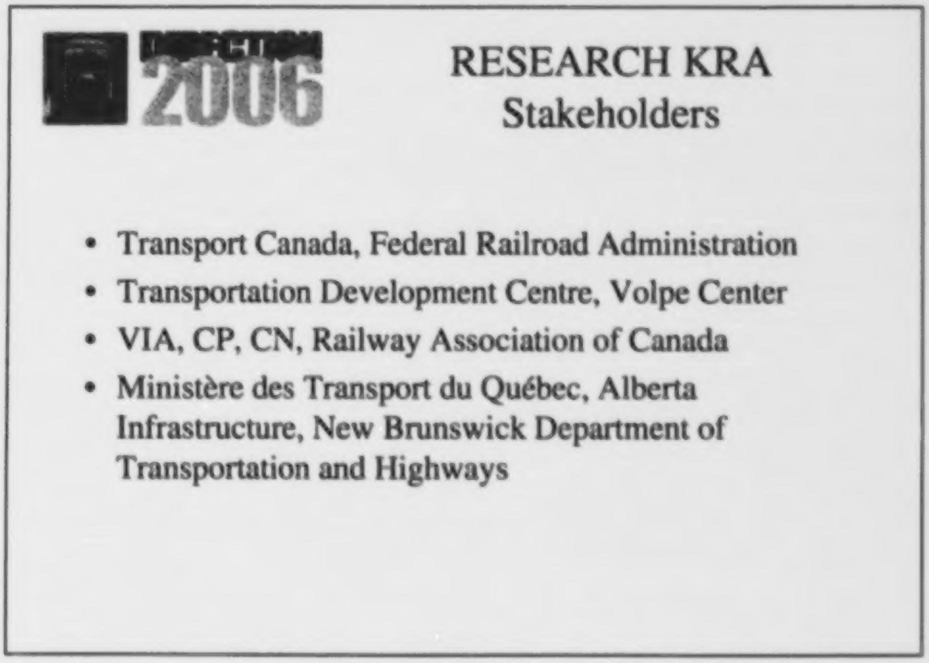
Seven Key Result Areas (KRA) were identified:

- Education
- Enforcement
- Engineering
- Research
- Legislative
- Resource
- Communication



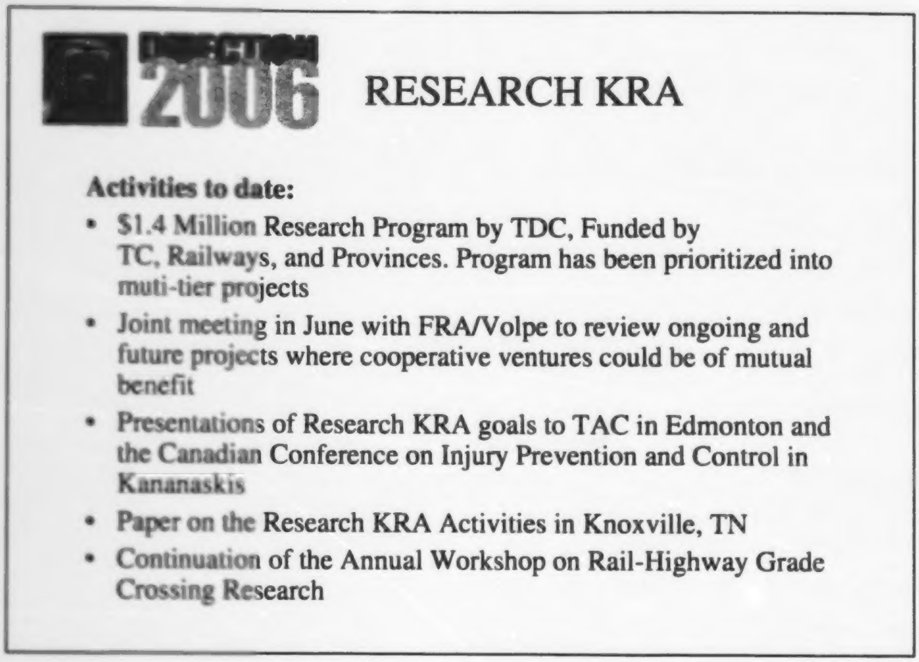
Research KRA Objectives

- To assist in reducing the number of rail-highway grade crossing collisions and trespassing incidents on railway property by 50% by the year 2006 through research on behaviour factors and new technology.



RESEARCH KRA Stakeholders

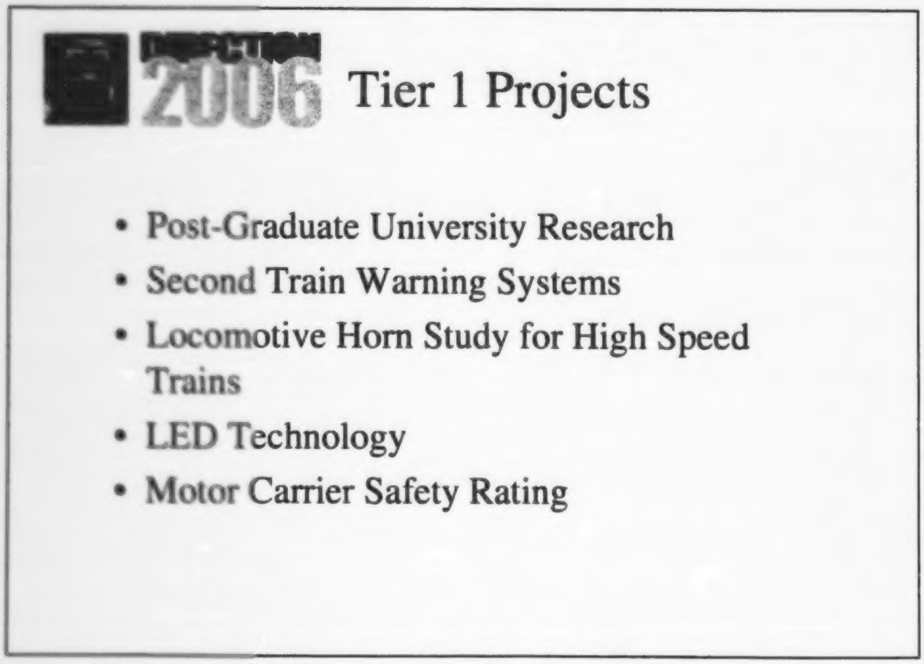
- Transport Canada, Federal Railroad Administration
- Transportation Development Centre, Volpe Center
- VIA, CP, CN, Railway Association of Canada
- Ministère des Transport du Québec, Alberta Infrastructure, New Brunswick Department of Transportation and Highways



RESEARCH KRA

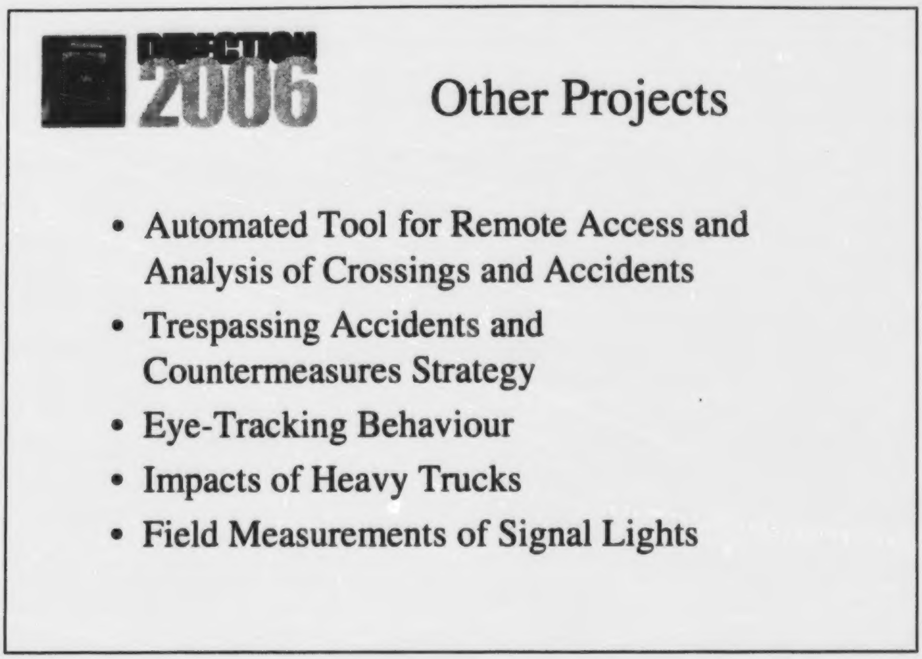
Activities to date:

- $1.4 Million Research Program by TDC, Funded by TC, Railways, and Provinces. Program has been prioritized into muti-tier projects
- Joint meeting in June with FRA/Volpe to review ongoing and future projects where cooperative ventures could be of mutual benefit
- Presentations of Research KRA goals to TAC in Edmonton and the Canadian Conference on Injury Prevention and Control in Kananaskis
- Paper on the Research KRA Activities in Knoxville, TN
- Continuation of the Annual Workshop on Rail-Highway Grade Crossing Research



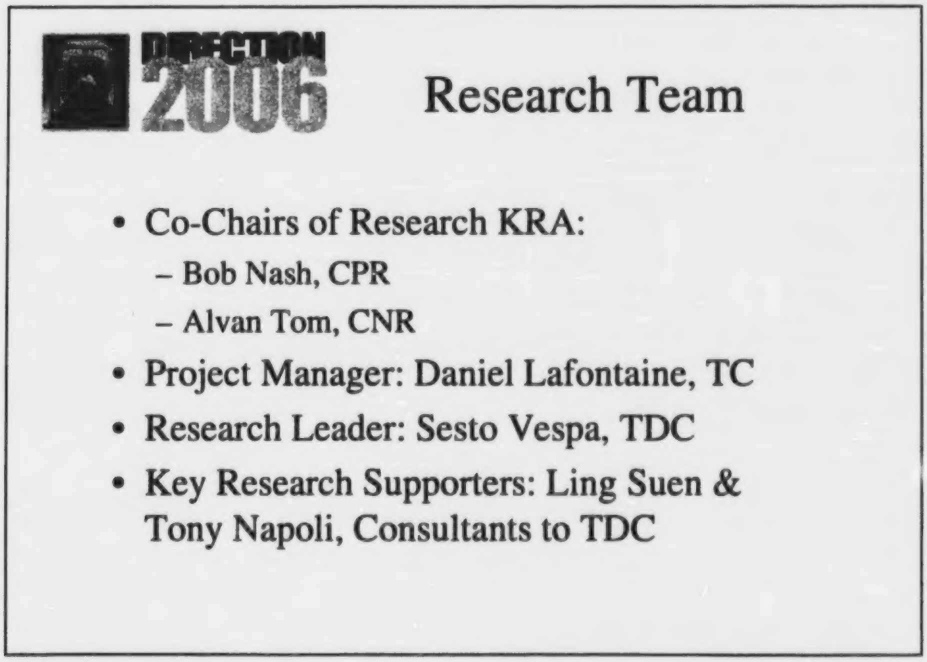
Tier 1 Projects

- Post-Graduate University Research
- Second Train Warning Systems
- Locomotive Horn Study for High Speed Trains
- LED Technology
- Motor Carrier Safety Rating



Other Projects

- Automated Tool for Remote Access and Analysis of Crossings and Accidents
- Trespassing Accidents and Countermeasures Strategy
- Eye-Tracking Behaviour
- Impacts of Heavy Trucks
- Field Measurements of Signal Lights



Research Team

- Co-Chairs of Research KRA:
  - Bob Nash, CPR
  - Alvan Tom, CNR
- Project Manager: Daniel Lafontaine, TC
- Research Leader: Sesto Vespa, TDC
- Key Research Supporters: Ling Suen & Tony Napoli, Consultants to TDC

Rail-Highway Grade Crossing Research Program – Update

Daniel Lafontaine
Transport Canada/Transports Canada
Rail Safety/Sécurité ferroviaire
Ottawa, Ontario

ABSTRACT

This presentation gives an update on the Rail-Highway Grade Crossing Research Program:

- Some research is in progress
- A technical review committee is evaluating several projects
- Five more are listed as the next priorities

It acknowledges the considerable efforts of everyone involved in the program: *Direction 2006* and its research KRA committee, financial and research partners, and, most of all, Transportation Development Centre personnel.

The 1999 Workshop gave the research program its initial momentum, when the forty participants supported the proposed projects and the partnership required to drive the work. Subsequently, partnership became the outstanding feature of the program, and collaborative efforts throughout the year have resulted in many refinements.

At the second workshop, further improvements to the research program are expected.

RÉSUMÉ

Le point sur le Programme de recherche sur les passages à niveau :

- Certains travaux de recherche sont déjà en cours
- Un comité d'examen technique procède à l'évaluation d'une série de projets
- Cinq autres projets figurent parmi les prochaines priorités

La présentation fait un rappel des efforts de tous les participants au programme : *Direction 2006* et son Comité sur la recherche, ses bailleurs de fonds et ses partenaires de recherche, et, surtout, le personnel du Centre de développement des transports.

Le programme de recherche a pris son élan lors de l'atelier de 1999. Les quarante participants ont alors donné leur appui aux projets proposés et ont été sensibilisés à l'esprit de coopération, essentiel à la bonne marche des travaux. Par la suite, le partenariat est devenu la marque distinctive du programme, et tout au cours de l'année, celui-ci a été peaufiné, à la faveur de consultations suivies.

Ce deuxième atelier devrait permettre d'améliorer encore ce programme de recherche.

RAIL-HIGHWAY GRADE CROSSING RESEARCH PROGRAM – UPDATE

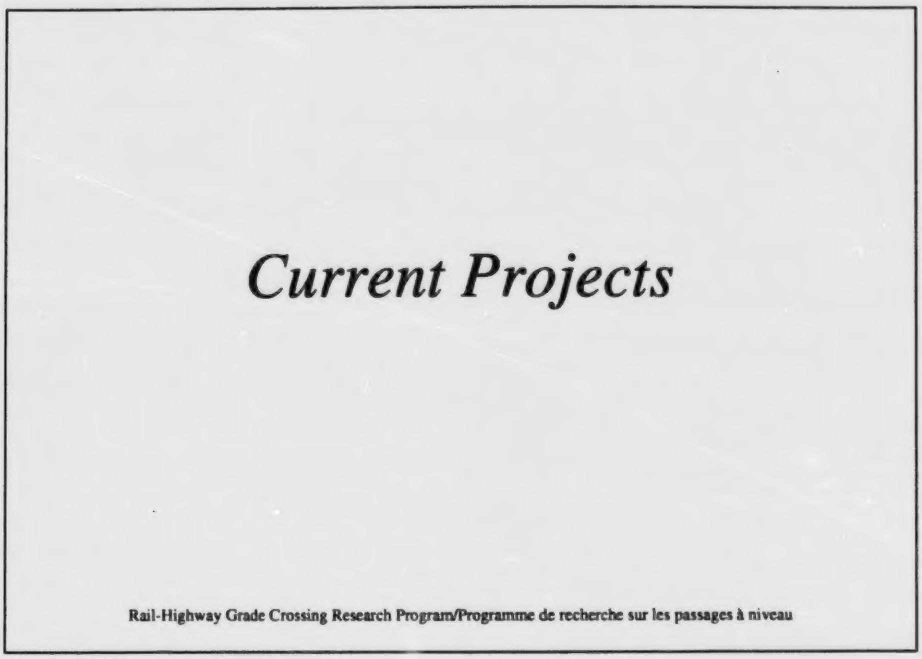
Grade Crossing Workshop
Atelier sur les passages à niveau

Rail-Highway Grade Crossing Research Program/Programme de recherche sur les passages à niveau

The Research Covers

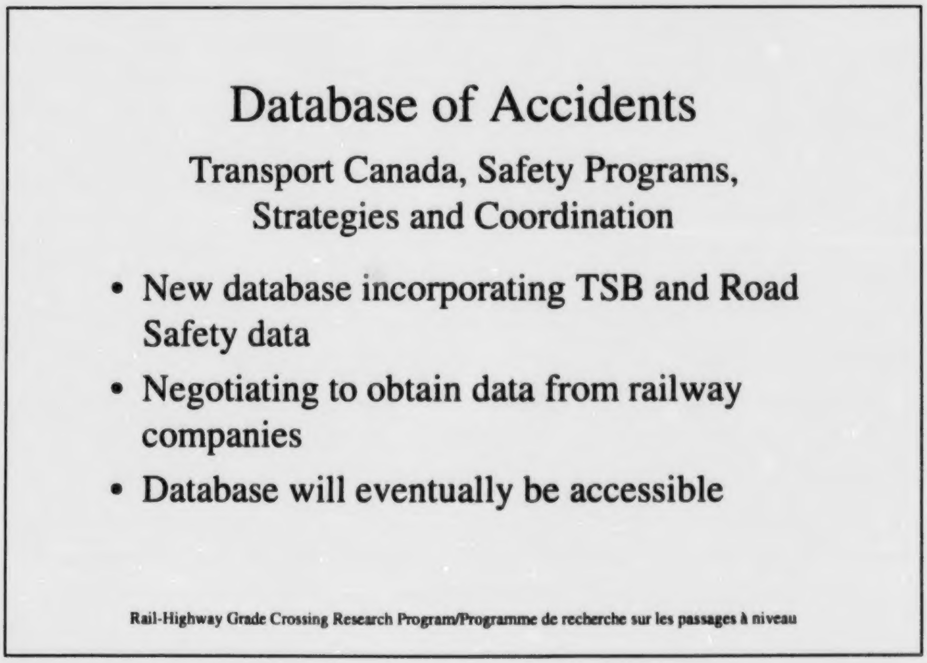
- New technologies for enhancing functionality and cost-effectiveness
- Driver and pedestrian safety behaviour at grade crossings
- Risk mitigation approach to implementing crossing safety improvements
- Causal analysis of crossing and trespassing accidents

Rail-Highway Grade Crossing Research Program/Programme de recherche sur les passages à niveau



Current Projects

Rail-Highway Grade Crossing Research Program/Programme de recherche sur les passages à niveau

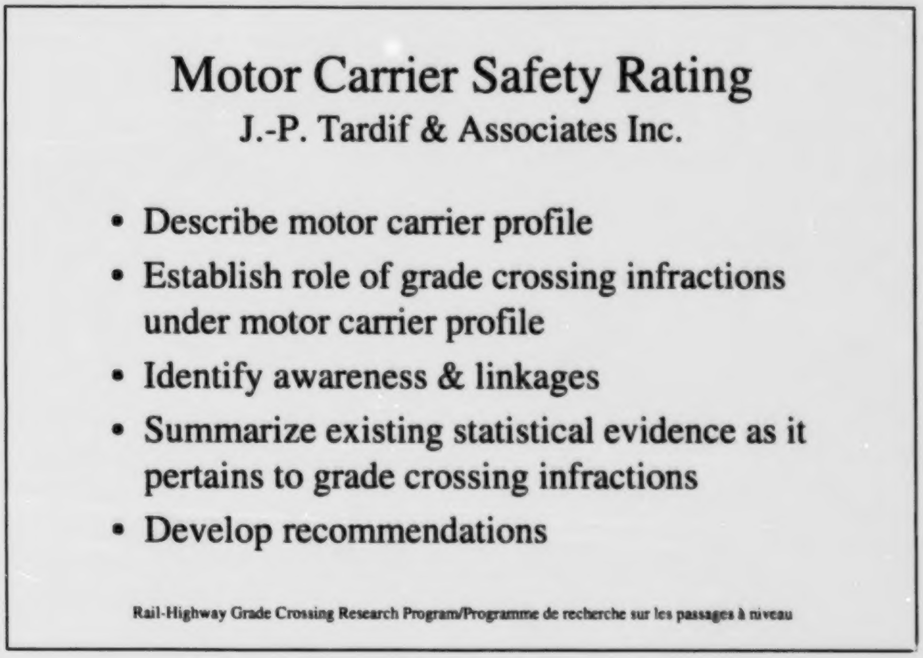


Database of Accidents

Transport Canada, Safety Programs, Strategies and Coordination

- New database incorporating TSB and Road Safety data
- Negotiating to obtain data from railway companies
- Database will eventually be accessible

Rail-Highway Grade Crossing Research Program/Programme de recherche sur les passages à niveau

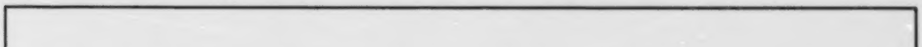


Motor Carrier Safety Rating

J.-P. Tardif & Associates Inc.

- Describe motor carrier profile
- Establish role of grade crossing infractions under motor carrier profile
- Identify awareness & linkages
- Summarize existing statistical evidence as it pertains to grade crossing infractions
- Develop recommendations

Rail-Highway Grade Crossing Research Program/Programme de recherche sur les passages à niveau



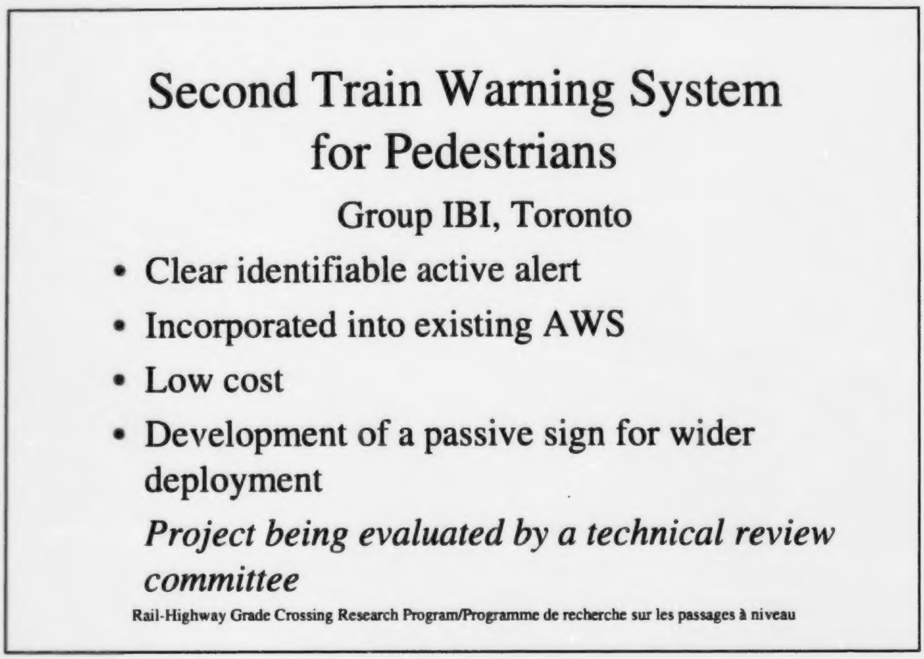
Post-Graduate University-Based Research

Dr. J. Caird, University of Calgary

- A human factors analysis of rail-highway grade crossing incidents in Canada

Project being evaluated by a technical review committee

Rail-Highway Grade Crossing Research Program/Programme de recherche sur les passages à niveau



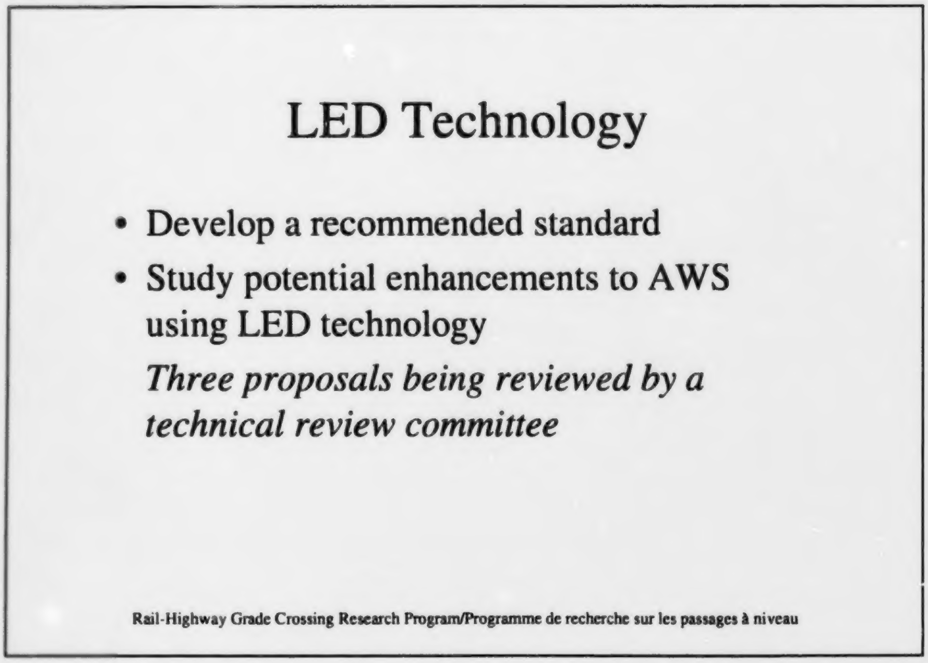
Second Train Warning System for Pedestrians

Group IBI, Toronto

- Clear identifiable active alert
- Incorporated into existing AWS
- Low cost
- Development of a passive sign for wider deployment

Project being evaluated by a technical review committee

Rail-Highway Grade Crossing Research Program/Programme de recherche sur les passages à niveau



LED Technology

- Develop a recommended standard
- Study potential enhancements to AWS using LED technology

Three proposals being reviewed by a technical review committee

Rail-Highway Grade Crossing Research Program/Programme de recherche sur les passages à niveau

Locomotive Horn Study

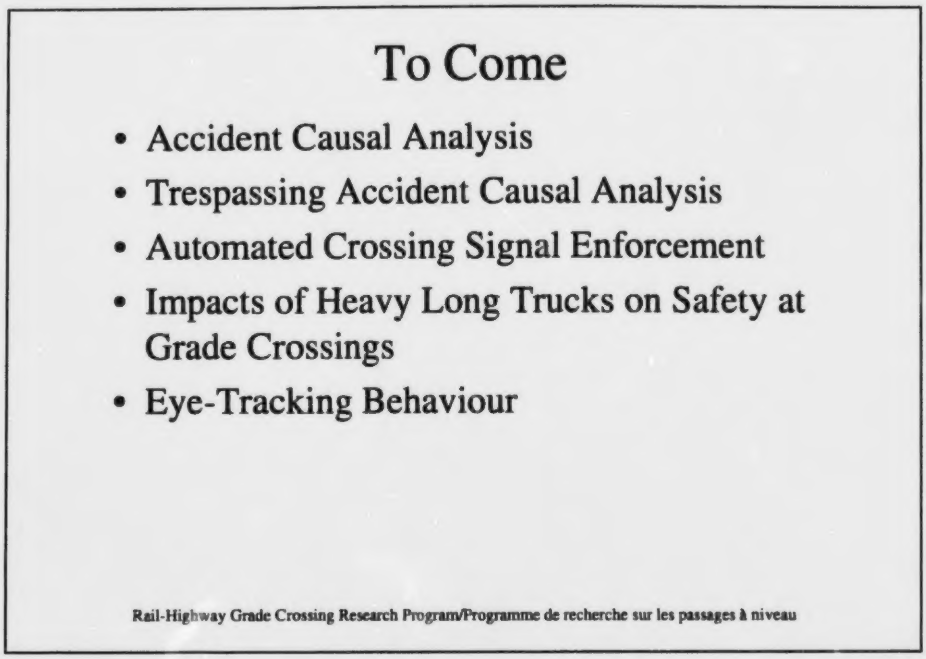
- Review current usage
- Determine optimal placement of horn on locomotive & assess potential benefits of modifying current frequencies or having multi-frequencies
- Consider human factors
- Assess potential benefits of an audible warning device at the grade crossing (wayside horn)

A proposal will be reviewed by a technical review committee

Rail-Highway Grade Crossing Research Program/Programme de recherche sur les passages à niveau

Next Priorities

Rail-Highway Grade Crossing Research Program/Programme de recherche sur les passages à niveau



To Come

- Accident Causal Analysis
- Trespassing Accident Causal Analysis
- Automated Crossing Signal Enforcement
- Impacts of Heavy Long Trucks on Safety at Grade Crossings
- Eye-Tracking Behaviour

U.S. Directions in Research and the Expectations

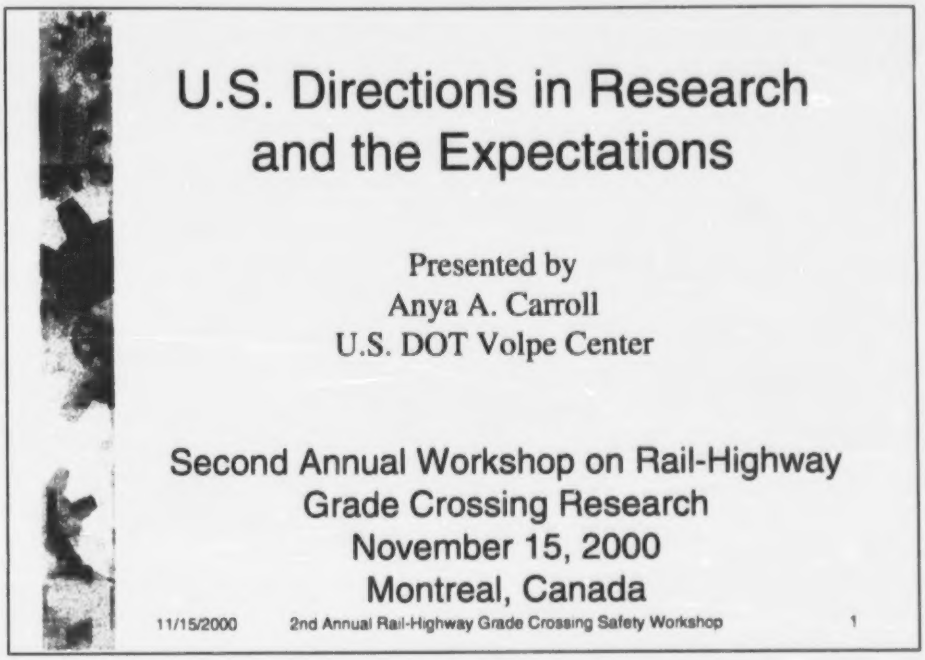
Anya A. Carroll
U.S. DOT Volpe National Transportation Systems Center
Cambridge, Massachusetts

ABSTRACT

This presentation highlights the Volpe Center's recent accomplishments, detailing two major undertakings: the School Street Project based on the use of four-quadrant gates integrated with train control and monitored by remote video; and the evaluation of alternative technologies for train and highway vehicle detection at grade crossings.

RÉSUMÉ

Cette présentation souligne les réalisations récentes du Volpe Center, et en particulier deux projets d'envergure : le projet *School Street*, qui utilise un système à quatre demi-barrières intégré à la commande des trains, et surveillé par caméra vidéo; et l'évaluation de nouvelles technologies pour la détection des trains et des véhicules routiers aux passages à niveau.

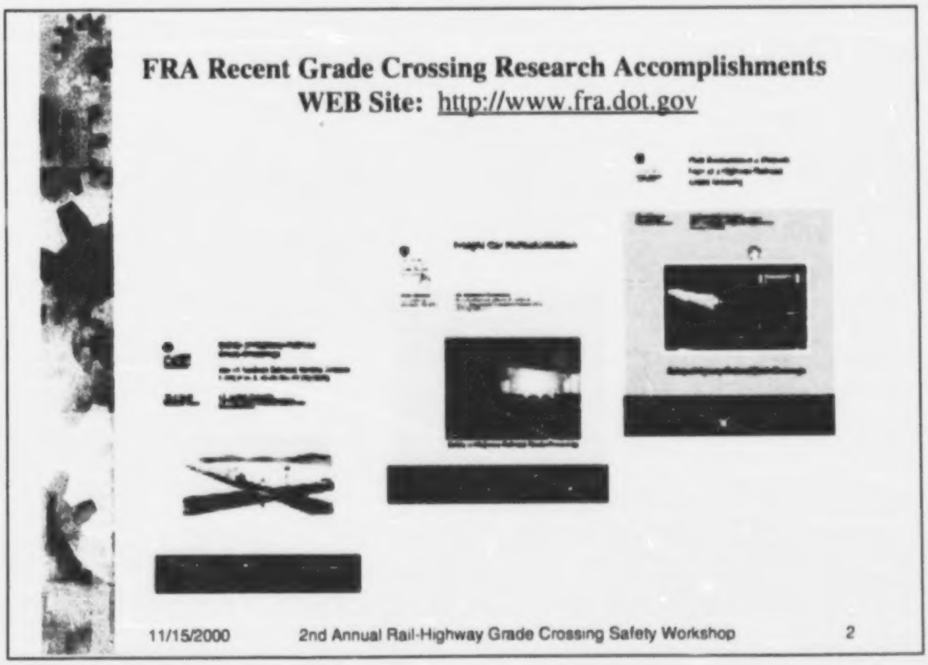


U.S. Directions in Research and the Expectations

Presented by
Anya A. Carroll
U.S. DOT Volpe Center

Second Annual Workshop on Rail-Highway
Grade Crossing Research
November 15, 2000
Montreal, Canada

11/15/2000 2nd Annual Rail-Highway Grade Crossing Safety Workshop 1



FRA Recent Grade Crossing Research Accomplishments
WEB Site: http://www.fra.dot.gov

11/15/2000 2nd Annual Rail-Highway Grade Crossing Safety Workshop 2

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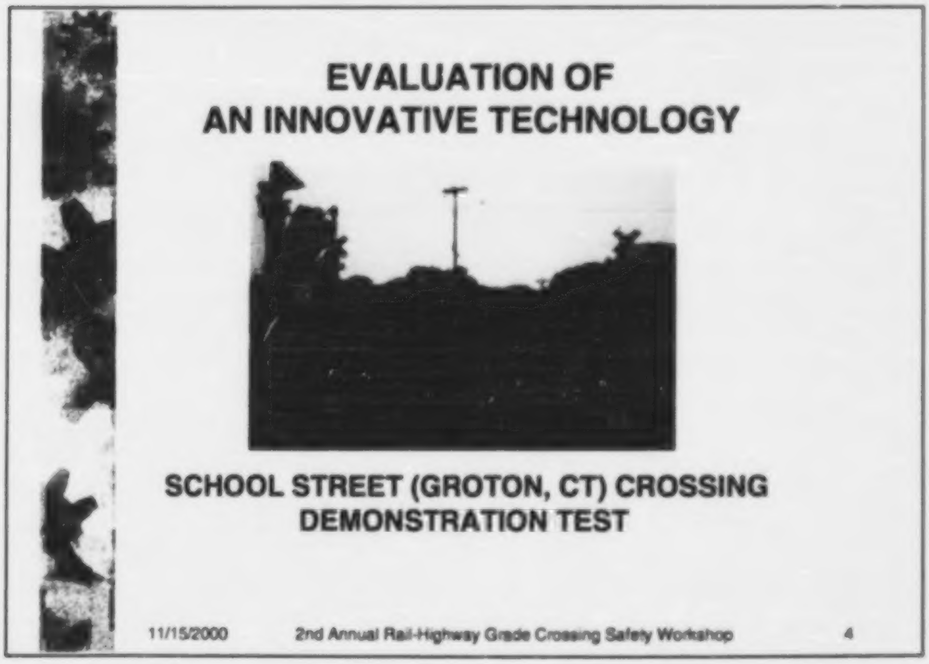

EVALUATION OF AN INNOVATIVE TECHNOLOGY

SCHOOL STREET (GROTON, CT) CROSSING DEMONSTRATION TEST

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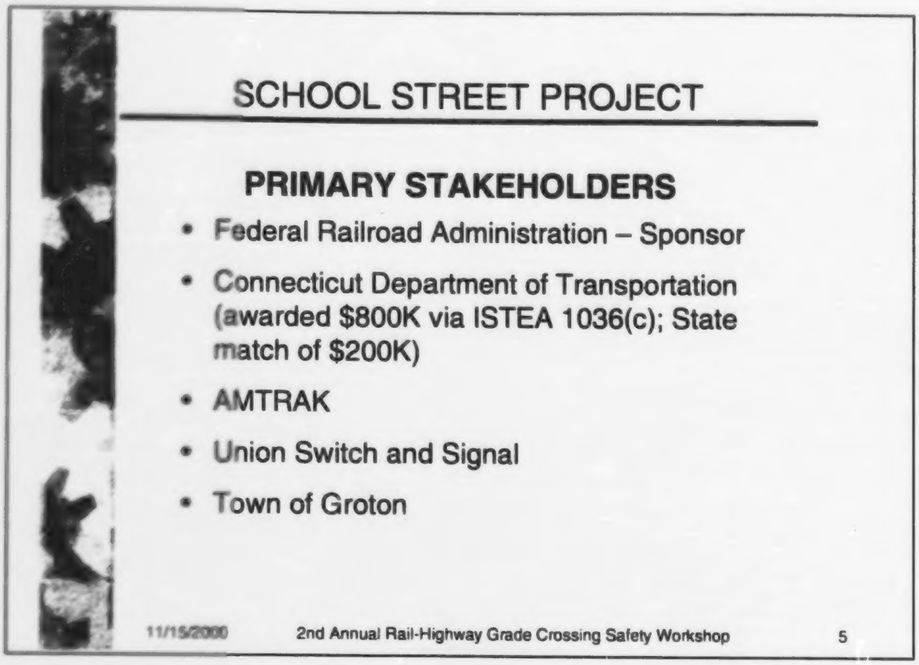
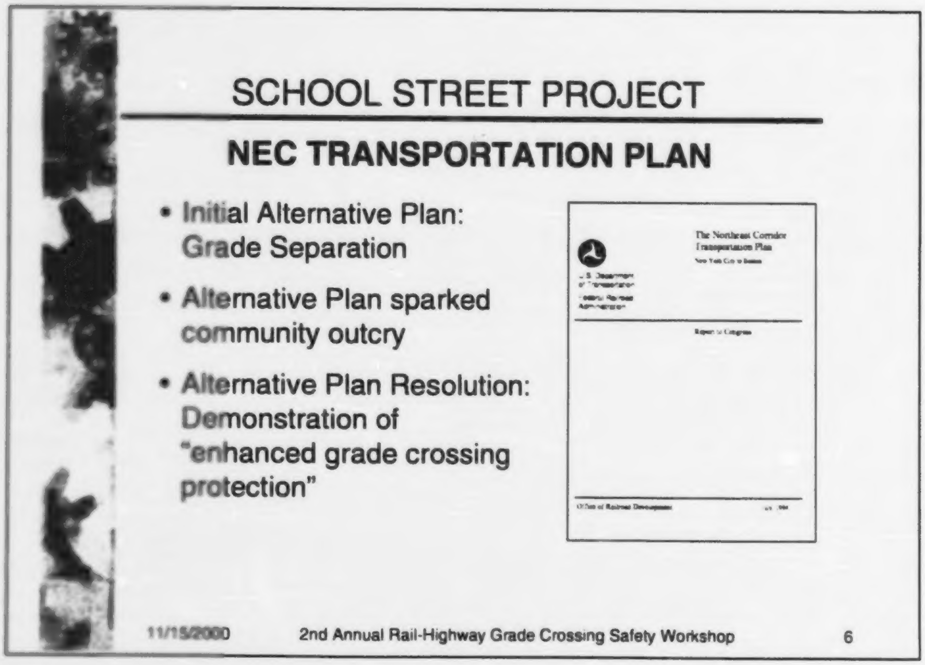


SCHOOL STREET PROJECT

PRIMARY STAKEHOLDERS

- Federal Railroad Administration – Sponsor
- Connecticut Department of Transportation (awarded $800K via ISTEA 1036(c); State match of $200K)
- AMTRAK
- Union Switch and Signal
- Town of Groton



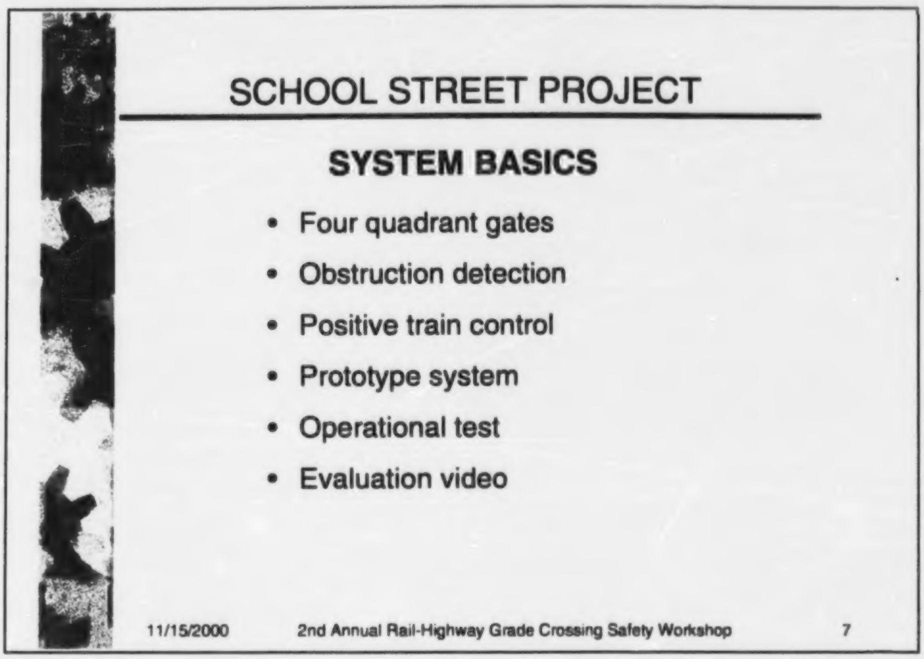
SCHOOL STREET PROJECT

NEC TRANSPORTATION PLAN

- Initial Alternative Plan: Grade Separation
- Alternative Plan sparked community outcry
- Alternative Plan Resolution: Demonstration of "enhanced grade crossing protection"

The Northeast Corridor Transportation Plan

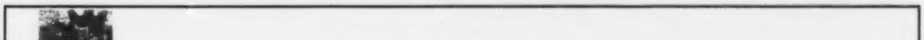
Report to Congress



SCHOOL STREET PROJECT

SYSTEM BASICS

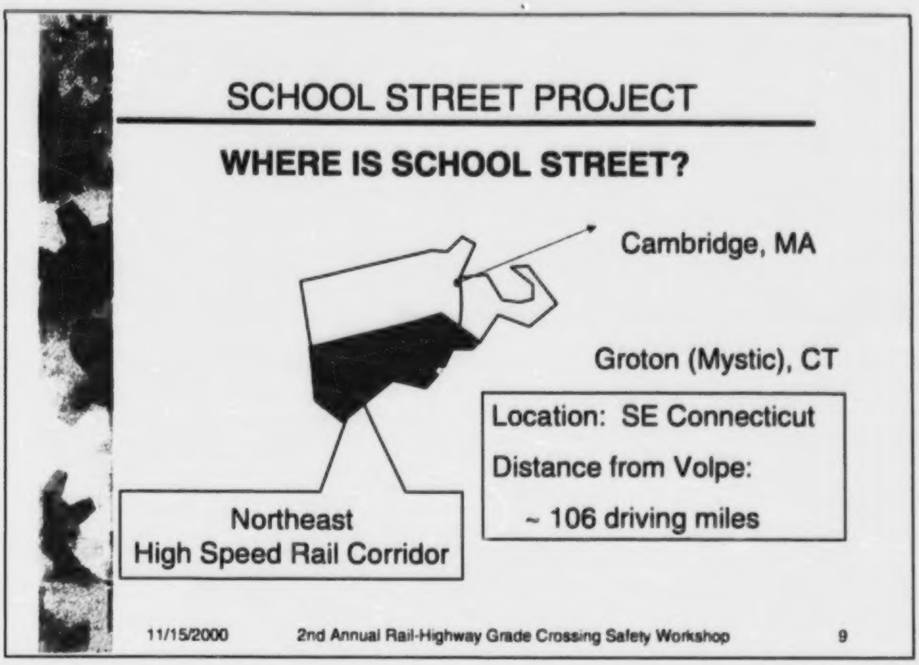
- Four quadrant gates
- Obstruction detection
- Positive train control
- Prototype system
- Operational test
- Evaluation video



SCHOOL STREET PROJECT

EVALUATION GOALS

- Operational performance
- Costs
- Institutional and legal issues related to the operation of the system
- User acceptance of the system (motorists, locomotive engineers, etc.)
- *Potential* impacts on safety



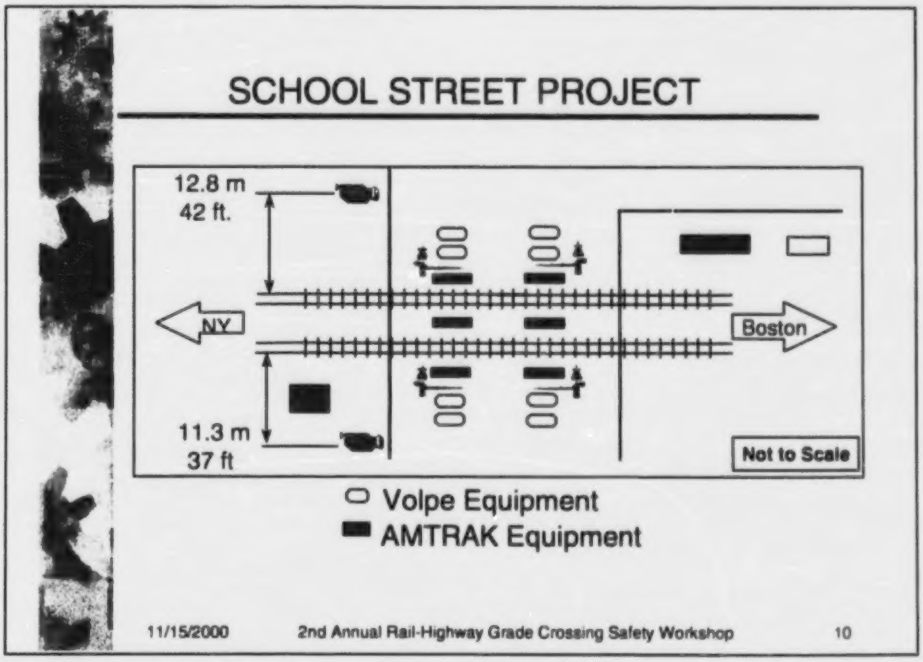
SCHOOL STREET PROJECT

WHERE IS SCHOOL STREET?

Cambridge, MA
Groton (Mystic), CT

Location: SE Connecticut
Distance from Volpe:
~ 106 driving miles

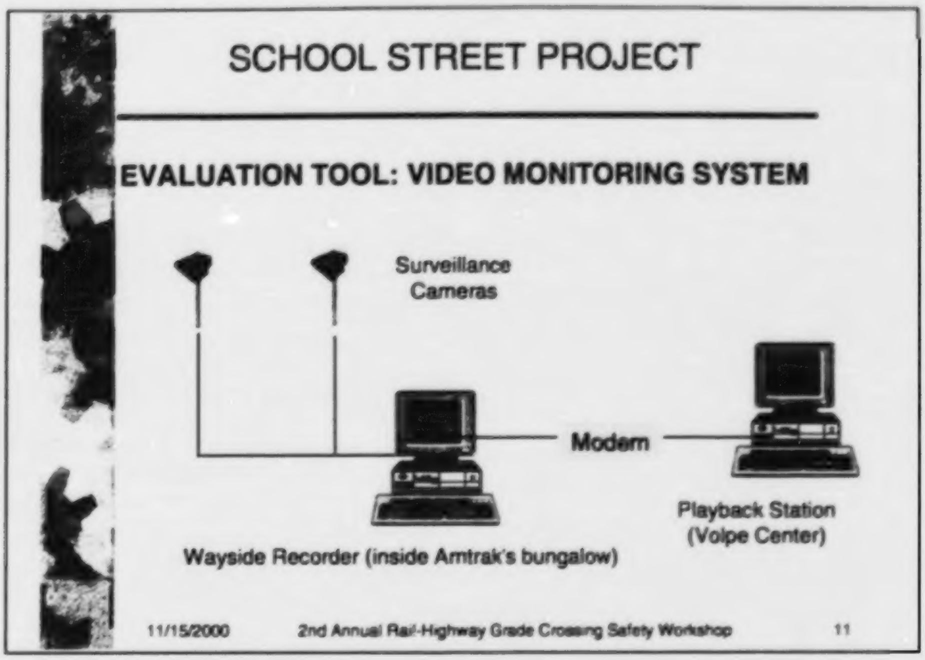
Northeast
High Speed Rail Corridor



SCHOOL STREET PROJECT

12.8 m
42 ft.
NY
Boston
11.3 m
37 ft
Not to Scale

○ Volpe Equipment
■ AMTRAK Equipment



SCHOOL STREET PROJECT

EVALUATION TOOL: VIDEO MONITORING SYSTEM

Surveillance
Cameras

Modem

Playback Station
(Volpe Center)

Wayside Recorder (inside Amtrak's bungalow)

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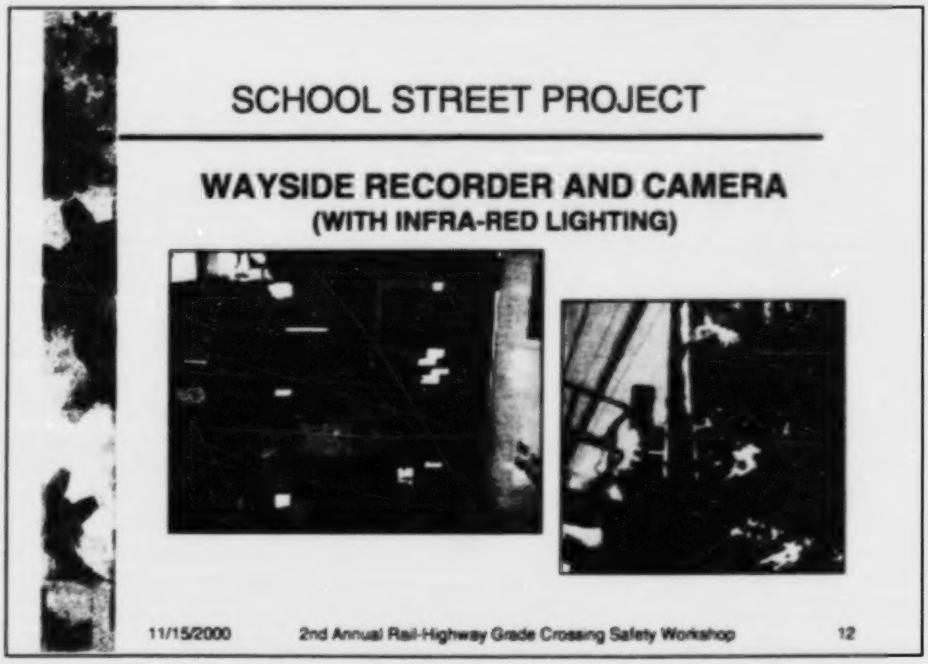

SCHOOL STREET PROJECT

WAYSIDE RECORDER AND CAMERA
(WITH INFRA-RED LIGHTING)

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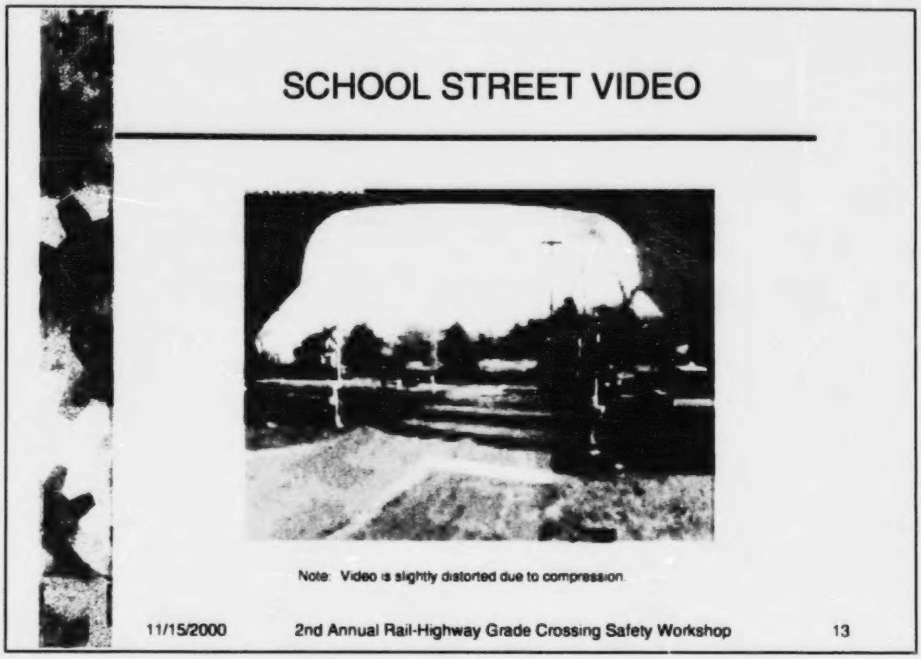
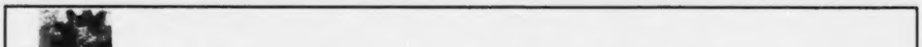


SCHOOL STREET VIDEO

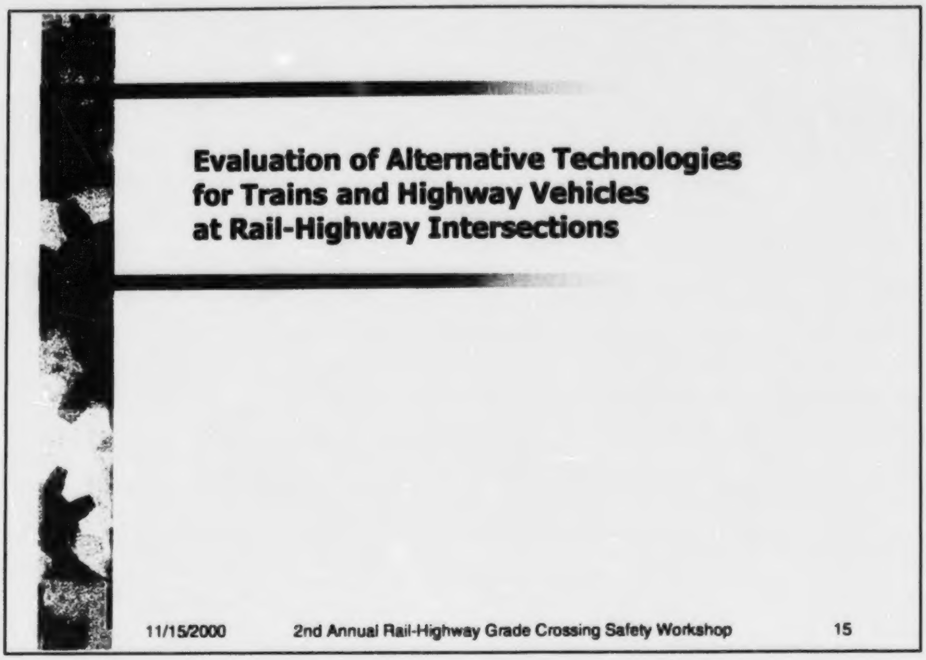
Note: Video is slightly distorted due to compression.



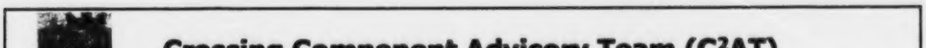
SCHOOL STREET PROJECT

CURRENT STATUS

- ~ 10,000 events captured; “Before & After” installation
- ~ 10 violations prior to 4QG installation
- **Zero** violations after 4QG installation
- No accidents reported
- Average vehicle traffic: 650 vpd
- Evaluation under way
- Additional 4QG installation: Palmer St. (Stonington, CT)
- A total of 4 additional 4QGs to be installed on NEC



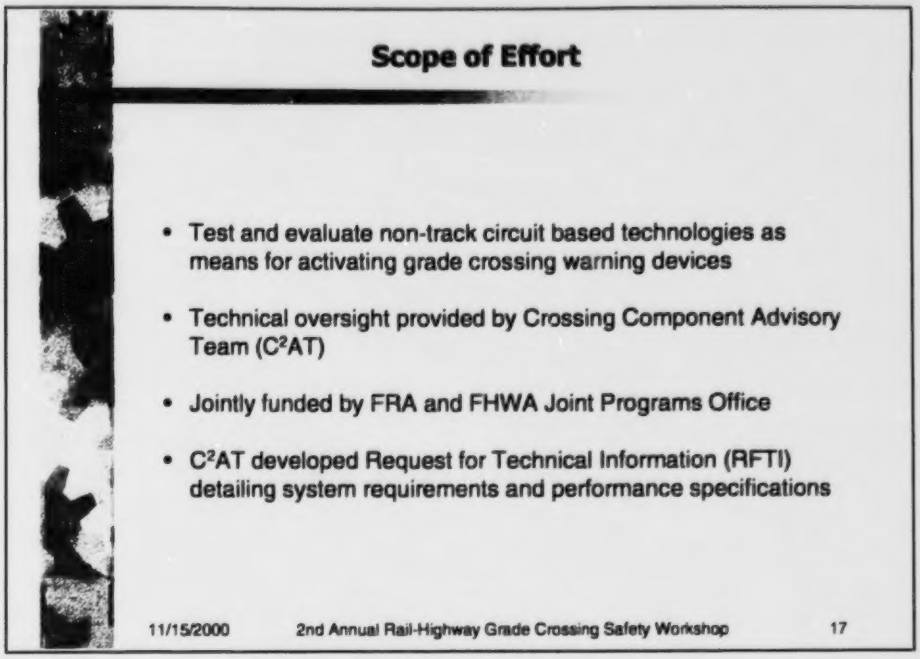
Evaluation of Alternative Technologies for Trains and Highway Vehicles at Rail-Highway Intersections



Crossing Component Advisory Team (C²AT)

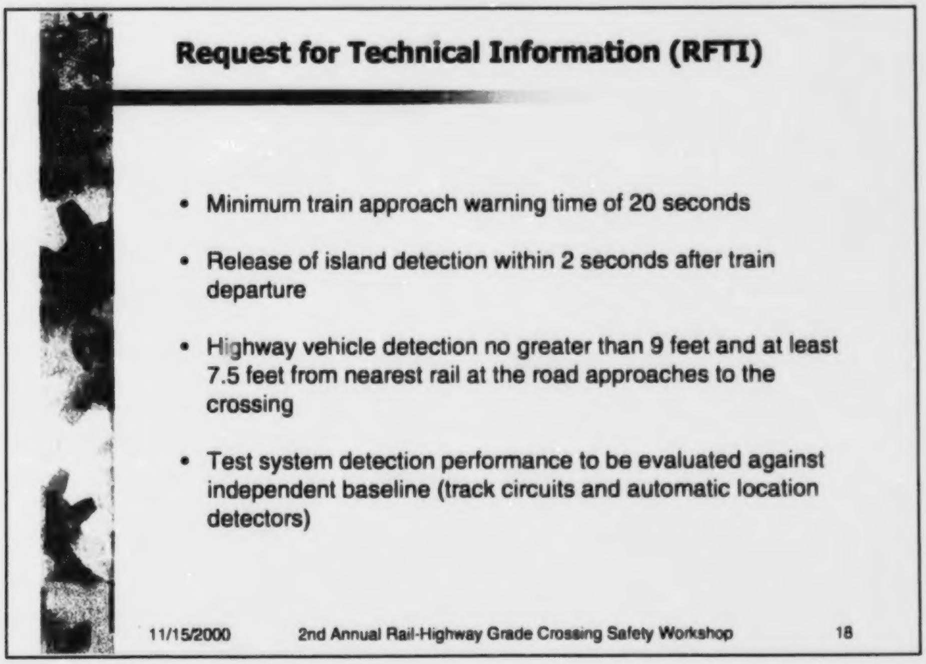
STAKEHOLDERS

- Federal Railroad Administration
- Volpe Center (Chair)
- Federal Highway Administration
- Association of American State Highway and Transportation Officials
- Transportation Research Board
- Norfolk Southern Railroad
- Canadian National Railroad
- CSX Transportation



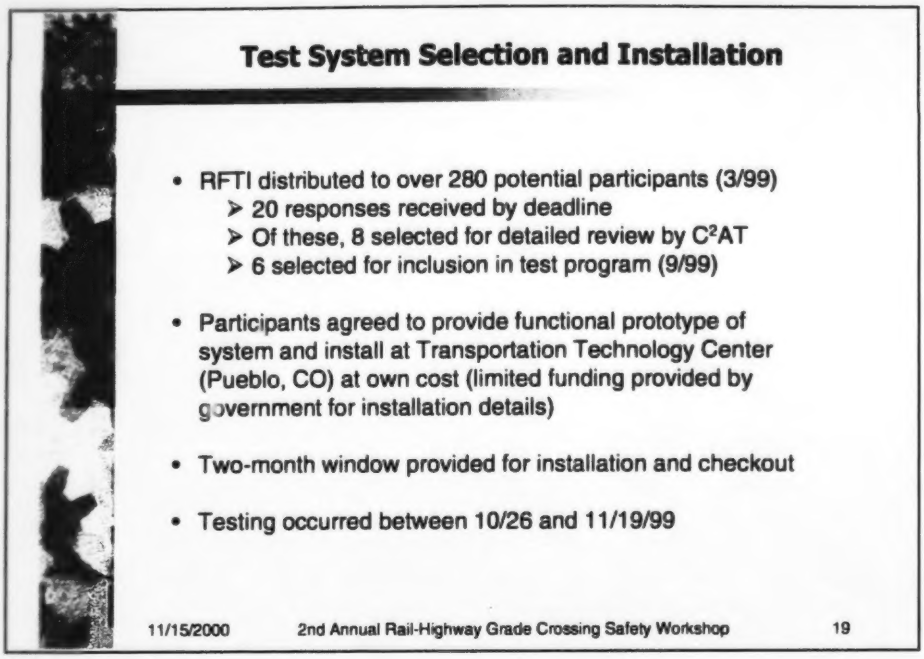
Scope of Effort

- Test and evaluate non-track circuit based technologies as means for activating grade crossing warning devices
- Technical oversight provided by Crossing Component Advisory Team (C^{2}AT)
- Jointly funded by FRA and FHWA Joint Programs Office
- C^{2}AT developed Request for Technical Information (RFTI) detailing system requirements and performance specifications



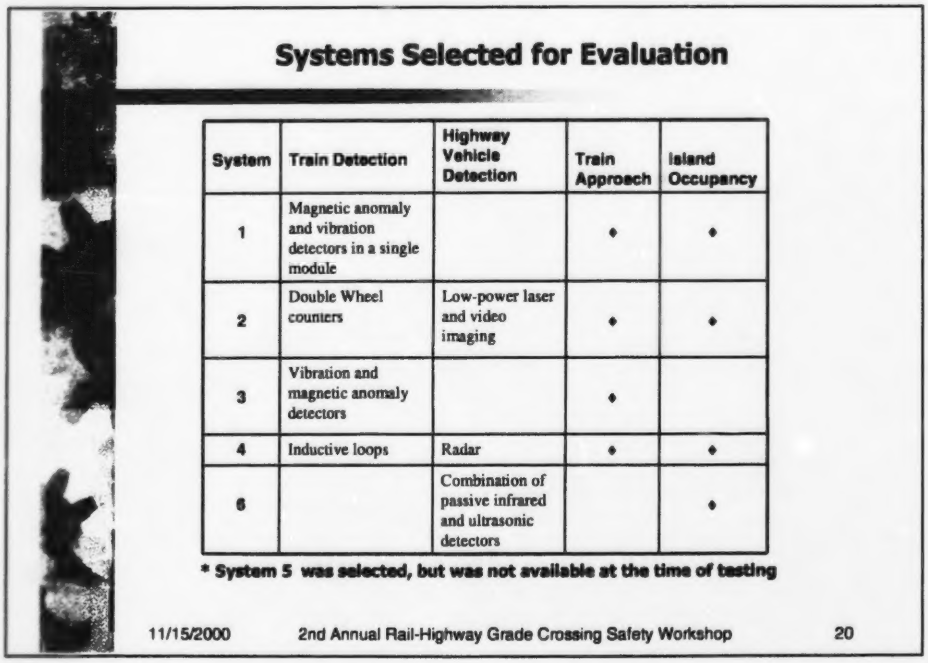
Request for Technical Information (RFTI)

- Minimum train approach warning time of 20 seconds
- Release of island detection within 2 seconds after train departure
- Highway vehicle detection no greater than 9 feet and at least 7.5 feet from nearest rail at the road approaches to the crossing
- Test system detection performance to be evaluated against independent baseline (track circuits and automatic location detectors)



Test System Selection and Installation

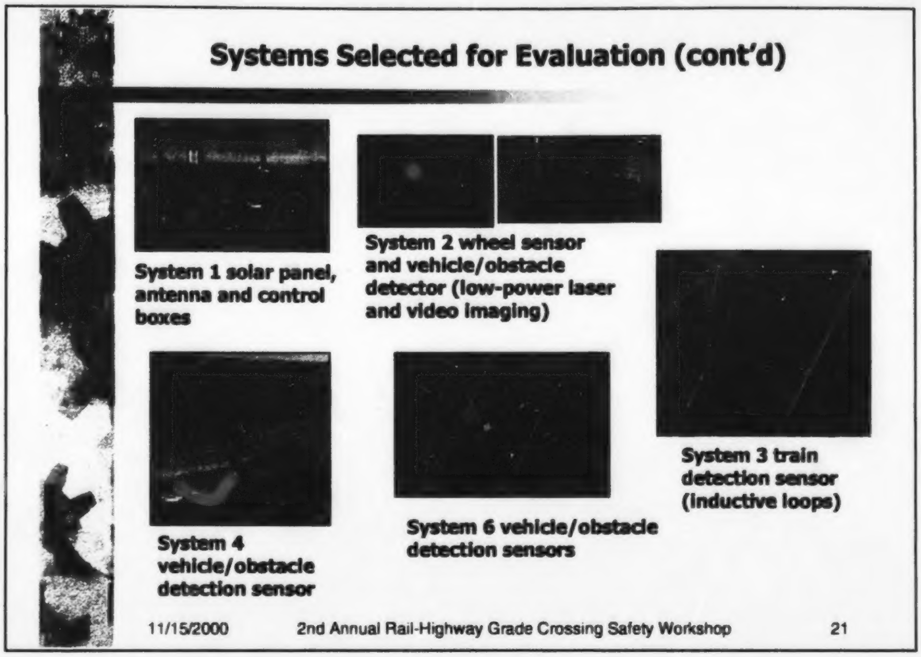
- RFTI distributed to over 280 potential participants (3/99)
  - 20 responses received by deadline
  - Of these, 8 selected for detailed review by C^{2}AT
  - 6 selected for inclusion in test program (9/99)
- Participants agreed to provide functional prototype of system and install at Transportation Technology Center (Pueblo, CO) at own cost (limited funding provided by government for installation details)
- Two-month window provided for installation and checkout
- Testing occurred between 10/26 and 11/19/99



Systems Selected for Evaluation

System	Train Detection	Highway Vehicle Detection	Train Approach	Island Occupancy
1	Magnetic anomaly and vibration detectors in a single module		◆	◆
2	Double Wheel counters	Low-power laser and video imaging	◆	◆
3	Vibration and magnetic anomaly detectors		◆	
4	Inductive loops	Radar	◆	◆
6		Combination of passive infrared and ultrasonic detectors		◆

*** System 5 was selected, but was not available at the time of testing**



Systems Selected for Evaluation (cont'd)

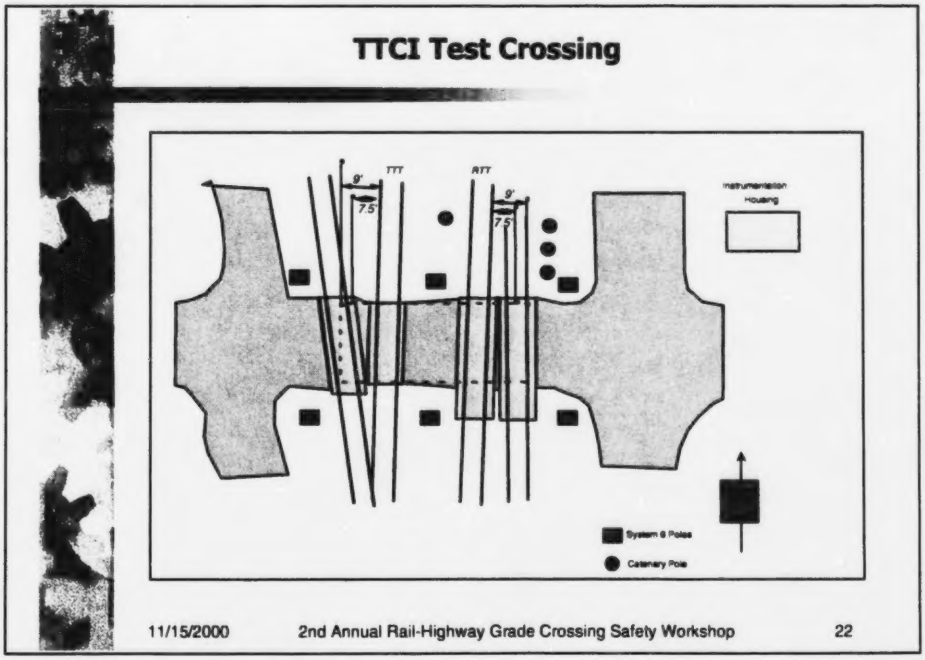
System 1 solar panel, antenna and control boxes

System 2 wheel sensor and vehicle/obstacle detector (low-power laser and video imaging)

System 3 train detection sensor (inductive loops)

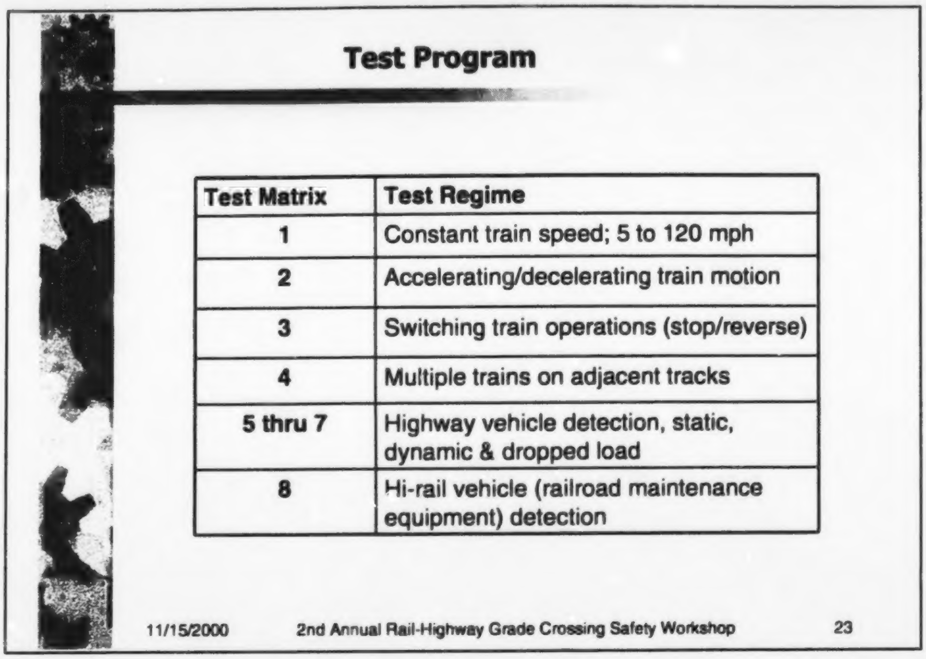
System 4 vehicle/obstacle detection sensor

System 6 vehicle/obstacle detection sensors



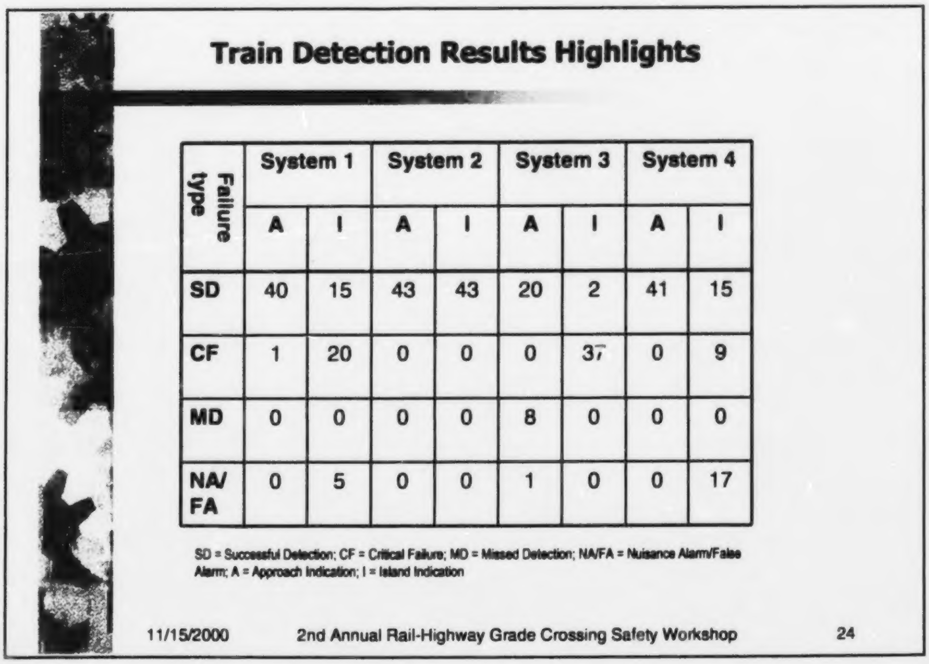
TTCI Test Crossing

9'
TTT
7.5'
ATT
9'
7.5'
Instrumentation Housing
System 6 Poles
Catenary Pole



Test Program

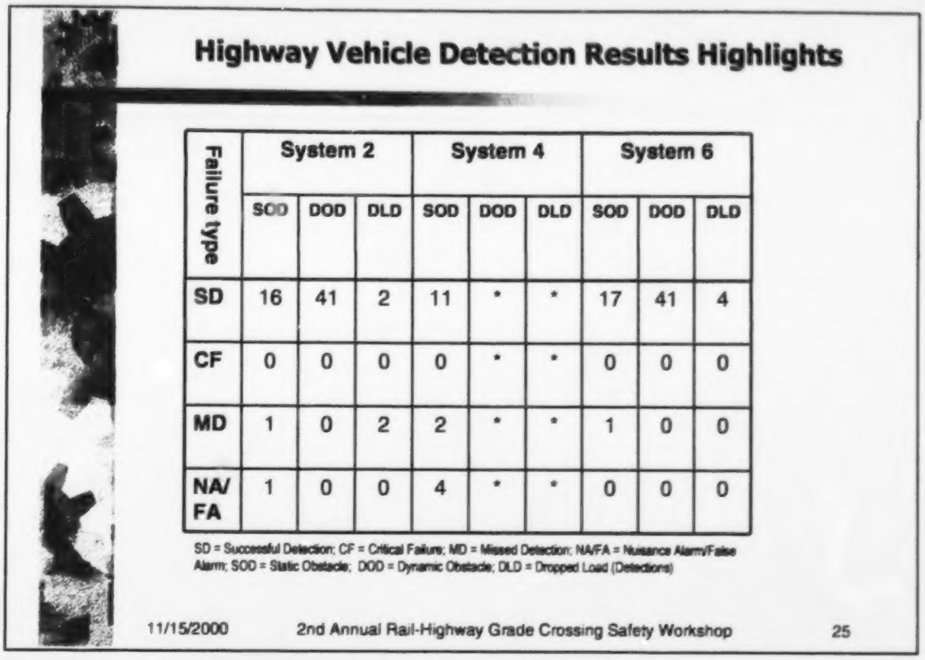
Test Matrix	Test Regime
1	Constant train speed; 5 to 120 mph
2	Accelerating/decelerating train motion
3	Switching train operations (stop/reverse)
4	Multiple trains on adjacent tracks
5 thru 7	Highway vehicle detection, static, dynamic & dropped load
8	Hi-rail vehicle (railroad maintenance equipment) detection



Train Detection Results Highlights

Failure type	System 1		System 2		System 3		System 4	
	A	I	A	I	A	I	A	I
SD	40	15	43	43	20	2	41	15
CF	1	20	0	0	0	37	0	9
MD	0	0	0	0	8	0	0	0
NA/FA	0	5	0	0	1	0	0	17

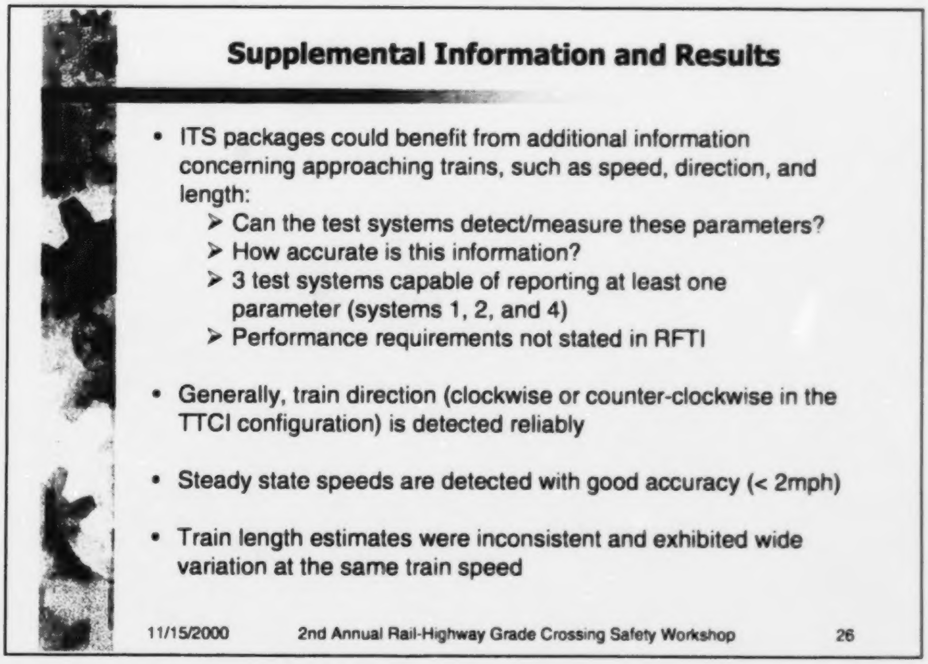
SD = Successful Detection; CF = Critical Failure; MD = Missed Detection; NA/FA = Nuisance Alarm/False Alarm; A = Approach Indication; I = Island Indication



Highway Vehicle Detection Results Highlights

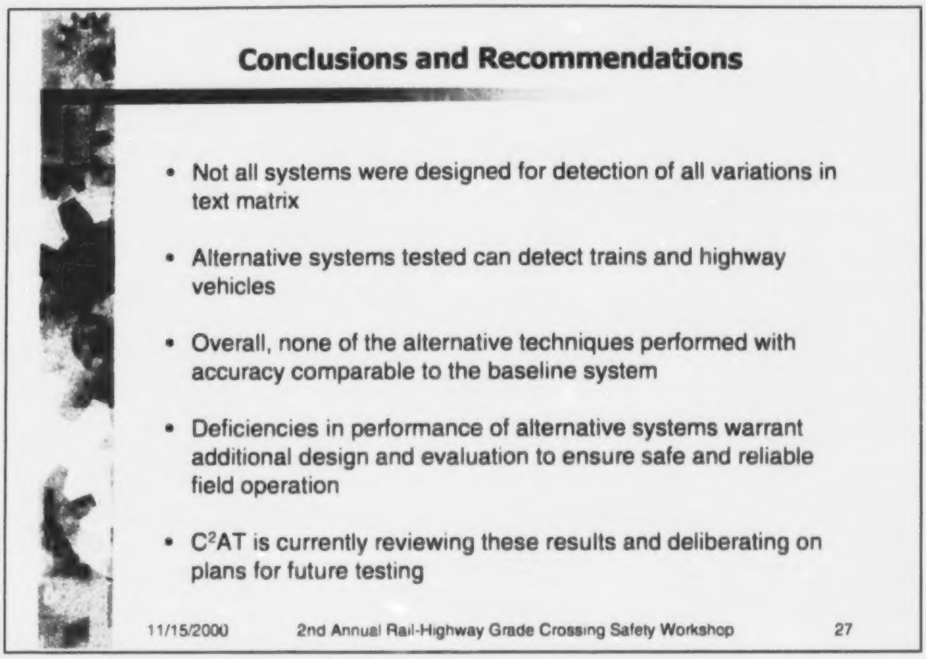
Failure type	System 2			System 4			System 6		
	SOD	DOD	DLD	SOD	DOD	DLD	SOD	DOD	DLD
SD	16	41	2	11	*	*	17	41	4
CF	0	0	0	0	*	*	0	0	0
MD	1	0	2	2	*	*	1	0	0
NA/ FA	1	0	0	4	*	*	0	0	0

SD = Successful Detection; CF = Critical Failure; MD = Missed Detection; NA/FA = Nuisance Alarm/False Alarm; SOO = Static Obstacle; DOO = Dynamic Obstacle; DLD = Dropped Load (Detections)



Supplemental Information and Results

- ITS packages could benefit from additional information concerning approaching trains, such as speed, direction, and length:
  - ➢ Can the test systems detect/measure these parameters?
  - ➢ How accurate is this information?
  - ➢ 3 test systems capable of reporting at least one parameter (systems 1, 2, and 4)
  - ➢ Performance requirements not stated in RFTI
- Generally, train direction (clockwise or counter-clockwise in the TTCI configuration) is detected reliably
- Steady state speeds are detected with good accuracy (< 2mph)
- Train length estimates were inconsistent and exhibited wide variation at the same train speed



Conclusions and Recommendations

- Not all systems were designed for detection of all variations in text matrix
- Alternative systems tested can detect trains and highway vehicles
- Overall, none of the alternative techniques performed with accuracy comparable to the baseline system
- Deficiencies in performance of alternative systems warrant additional design and evaluation to ensure safe and reliable field operation
- C^2AT is currently reviewing these results and deliberating on plans for future testing

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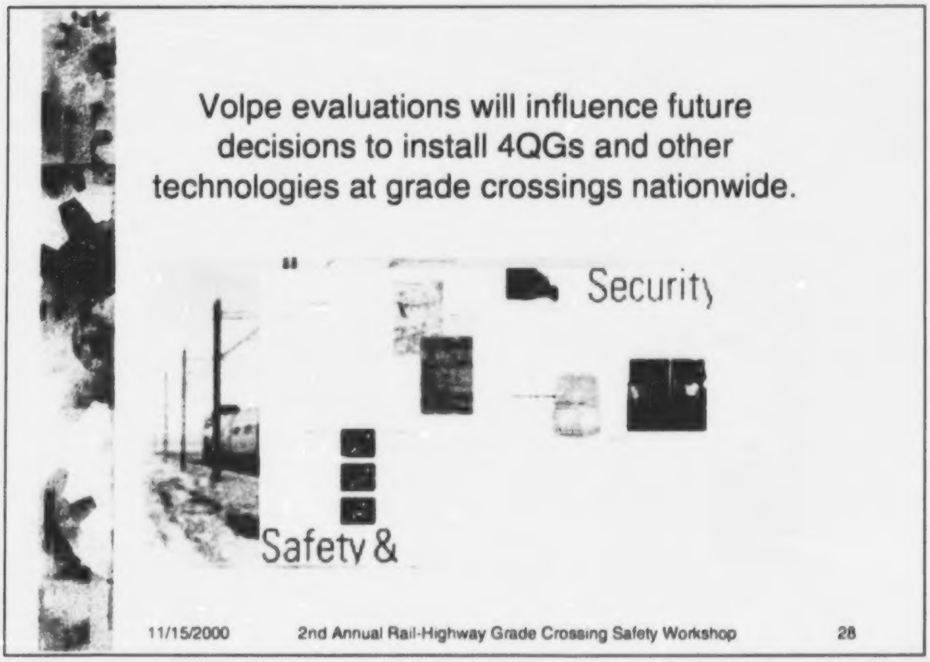


Volpe evaluations will influence future decisions to install 4QGs and other technologies at grade crossings nationwide.

Security
Safety &

11/15/2000 2nd Annual Rail-Highway Grade Crossing Safety Workshop 28

always expect a train

Grade Crossing Accidents: Investigating the Aftermath

Mario Péloquin
Transportation Safety Board of Canada/Bureau de la sécurité des transports du Canada
Hull, Quebec

SUMMARY

The Transportation Safety Board of Canada (TSB) is the agency with the legislative authority to investigate transportation accidents and incidents in order to make findings as to their causes and contributing factors. The TSB's sole mandate is to advance transportation safety.

Crossing accidents on railways under federal jurisdiction, among other occurrences, are reported to the TSB. The Board decides whether to investigate based on an evaluation process. Investigations are conducted in cooperation with the police and the coroner.

The TSB investigators follow documented procedures to determine the conditions leading to the crossing accident and prepare a report that, once completed, becomes a public document. The report can contain safety information based on the findings and geared to advancing transportation safety.

Although many factors contribute to crossing accidents, a majority of investigations identify human error in their findings.

SOMMAIRE

Le Bureau de la sécurité des transports du Canada (BST) est l'organisme auquel est conférée l'autorisation législative de mener des enquêtes sur les accidents et incidents du secteur des transports, afin de tirer des conclusions quant aux causes et aux facteurs contributifs de ces accidents. Le seul et unique mandat du BST est de promouvoir la sécurité dans les transports.

Les accidents aux passages à niveau de lignes de chemins de fer de compétence fédérale font partie des événements signalés au BST. Le Bureau évalue d'abord les circonstances de l'accident avant de décider s'il y a lieu d'instituer une enquête. Les enquêtes sont menées en collaboration avec la police et le coroner.

Les enquêteurs du BST se reportent à des procédures écrites pour déterminer les conditions qui ont mené à l'accident et préparent un rapport qui est mis à la disposition du public. Ce rapport peut

contenir des informations en matière de sécurité rendues pertinentes par les résultats de l'enquête, et destinées à promouvoir la sûreté des transports.

De nombreux facteurs contribuent aux accidents aux passages à niveau. Mais la majorité des enquêtes concluent que l'erreur humaine a un rôle à jouer.

THE TRANSPORTATION SAFETY BOARD OF CANADA (TSB) is the agency with the legislative authority to investigate transportation accidents and incidents in order to make findings as to their causes and contributing factors. The TSB's sole mandate is to advance transportation safety.

To discharge this mandate, independent investigations and, if necessary, public inquiries are conducted. The Board then reports publicly on its investigations and public inquiries and on the related findings. The Board also identifies safety deficiencies as evidenced by transportation occurrences and makes recommendations designed to eliminate or reduce such deficiencies. It is not the function of the Board to assign fault or determine civil or criminal liability. The findings of the Board are not binding on the parties to any legal, disciplinary, or other proceedings. In fact, legislation provides a very high level of protection to any witness interviewed by investigators.

Under the Board's legislative authority, railways are required to report certain types of accidents and incidents. The regulations attached to the Canadian Transportation Accident Investigation and Safety Board Act indicate that if an accident results directly from the operation of rolling stock, where the rolling stock is involved in a grade-crossing collision, that accident must be reported to the TSB.

Upon notification of such an occurrence, and once sufficient information has been obtained, a decision is made regarding the appropriate level of response from the TSB. In some cases, no immediate response is deemed warranted, while on other occasions an investigator or a team of investigators may be deployed. All these steps must be taken while considering that any delays may retard the resumption of railway service.

Crossing accidents are often psychologically the most difficult for TSB rail investigators to investigate because of the nature of the injuries. Generally, rail investigators have to witness more injuries and fatalities at crossing and trespassing accidents than at any other type of occurrence.

All crossing accidents are under police jurisdiction by virtue of highway traffic legislation and Coroners' Acts. Normally, the TSB will investigate if there is a belief that the railway operations or adherence to applicable standards are in question, if a systemic crossing safety issue is involved or perceived to be involved, or if the public appears to expect the TSB to investigate. It is important to note that investigating individual crossing accidents generally does not have a high probability of advancing Canadian transportation safety by reducing the risk to persons, property, or the environment. However, it is recognized that these accidents have a very serious impact on the people involved or their next of kin.

Once the decision to deploy an investigator or investigators has been made, the team travels to the site and begins collecting the information necessary to develop findings as to the cause and contributing factors. The team is composed of experts in various fields of investigation (operations, infrastructure, human performance, engineering) and the direction the investigation takes is determined by the evidence found on the site.

The TSB has adopted an investigations methodology called Integrated Safety Investigations Methodology (ISIM), which provides a detailed step-by-step methodology to ensure that all appropriate investigative steps have been taken and that all issues are properly validated. This methodology is applied to all TSB investigations.

The rail investigators also have a Rail Investigations Manual that contains items to be examined in most types of investigations. The chapter for crossing accident investigations makes it clear that the guidelines are for investigating a crossing accident involving a train and a motor vehicle, but the same requirements are applicable in a train/snowmobile/ATV occurrence or train/pedestrian occurrence.

It details such logical items as surface composition and condition of the crossing, track condition and physical characteristics, sight lines, warning devices, lighting, signs and placement of road traffic lights, and their interconnection with crossing signals.

Many of the aspects of crossing accident investigations are conducted in cooperation with the police and the coroner. The coroner, who has concurrent authority with the TSB in investigating fatalities, shares findings related to the physical characteristics of the occupants, including the presence of drugs or alcohol in the blood stream. The police information is also a helpful tool in assessing the driver's role in an occurrence.

After examining all the physical evidence and conducting appropriate interviews of train crew, survivors, and other witnesses, the investigation examines the event recorders on the locomotive and the crossing protection bungalow (if it has an event recorder) to identify possible unsafe conditions. This examination, in conjunction with statements of witnesses, can lead to examination of the operation of warning devices. If circumstances warrant, the TSB or police department may elect to study the mechanical fitness of the road vehicle involved, as well as the appropriateness of the legislation ensuring vehicle fitness and of provincial driver education programs (e.g., for beginners and/or truck drivers). Tractor-trailer acceleration studies have been performed to assess whether these vehicles had sufficient time to safely pass a crossing. Increasingly, vehicles also contain microchips, which, with the cooperation of the manufacturer, can give valuable information about the operation of the vehicle.

With all that information, the TSB can usually re-create the events leading to an accident and develop findings as to the cause and contributing factors leading to an accident.

To demonstrate the seriousness of crossing accidents in Canada, a few statistics are provided:

Year	1999 (Jan. 1 - Nov. 3)	2000 (Jan. 1 - Nov. 3)
Public automated	104	108
Public passive	73	65
Private	41	31
Farm	8	2
Total	226	206

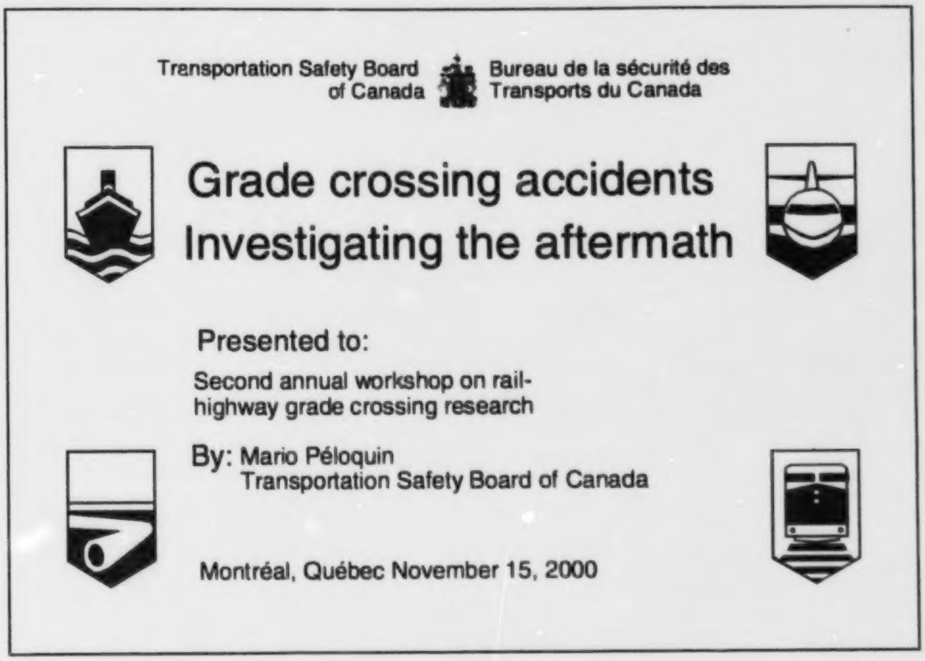
In 2000, from January 1 to November 3, 36 crossing accidents involving a heavy truck occurred; 39 occurred in the same period in 1999; this indicates a constant rate of 17% of all crossing accidents.

A total of 17 passenger trains (of all types) were involved in crossing accidents between January 1 and November 3, 2000 (8% of all crossing accidents). During the same period in 1999, 24 were involved (11% of all crossing accidents).

In 1999, five investigations involving crossing accidents were undertaken, all involving passenger trains and three involving heavy trucks. In 2000 to date, two such investigations have been undertaken, both involving passenger trains and one involving a heavy truck. As logic would dictate, most recent investigations involved passenger trains and trucks, as these appear to have the most severe consequences.

Investigations have determined such issues as sightlines not in accordance with the applicable guidelines, procedural deficiencies while work was ongoing on the crossing, vehicle operator not observing or reacting to an approaching train or not complying with highway traffic act provisions (e.g. stop signs), and possible technology flaws. In a majority of cases, the accidents are believed to be a direct result of human error. However, initiatives currently on test and, in some cases, implemented in the United States will certainly go a long way towards preventing some of these occurrences.

It has been observed that many crossing accidents occur because of people's impatience, complacency with a repetitive route, or bad judgment and decisions. Forums like today's demonstrate a high level of awareness of the issues and an attempt to find a remedy for these problems, which could be categorized as social in nature. The TSB certainly has its part to play in advancing safety relating to crossing accidents and will continue to apply the appropriate level of resources to achieve this goal.



Transportation Safety Board of Canada
Bureau de la sécurité des Transports du Canada

Grade crossing accidents
Investigating the aftermath

Presented to:

Second annual workshop on rail-highway grade crossing research

By: Mario Péloquin
Transportation Safety Board of Canada

Montréal, Québec November 15, 2000

Transportation Safety Board of Canada

Mandate

- ***Advance transportation safety by:***
  - Conducting independent investigations
  - Reporting publicly on its investigations and on the related findings
  - Identifying safety deficiencies
  - Making recommendations
  - Conducting special investigations and studies on transportation safety matters

TSB Investigation Reports

- Made public
- Sent to railways, Transport Canada, persons with a direct interest (PDI)
- Available from TSB or from Internet

www.bst-tsb.gc.ca

☎ 819-994-3741

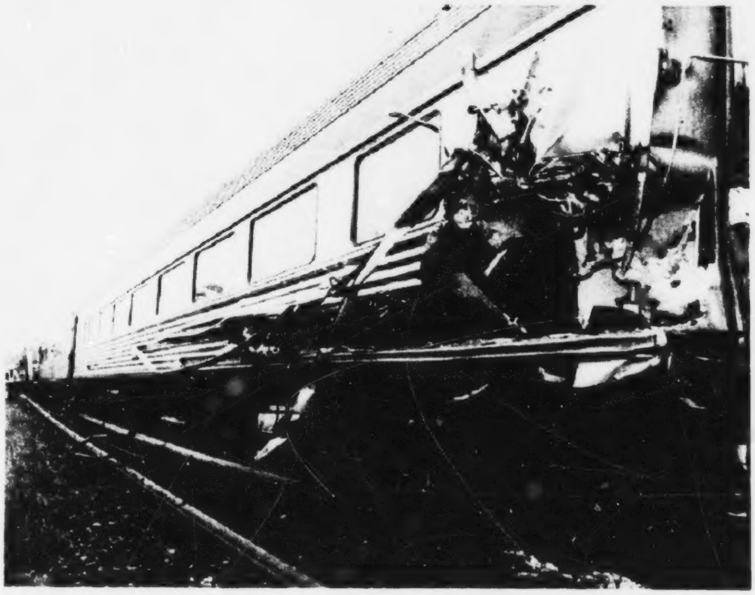
Reporting accidents/incidents to the TSB

Transportation Safety Board of Canada

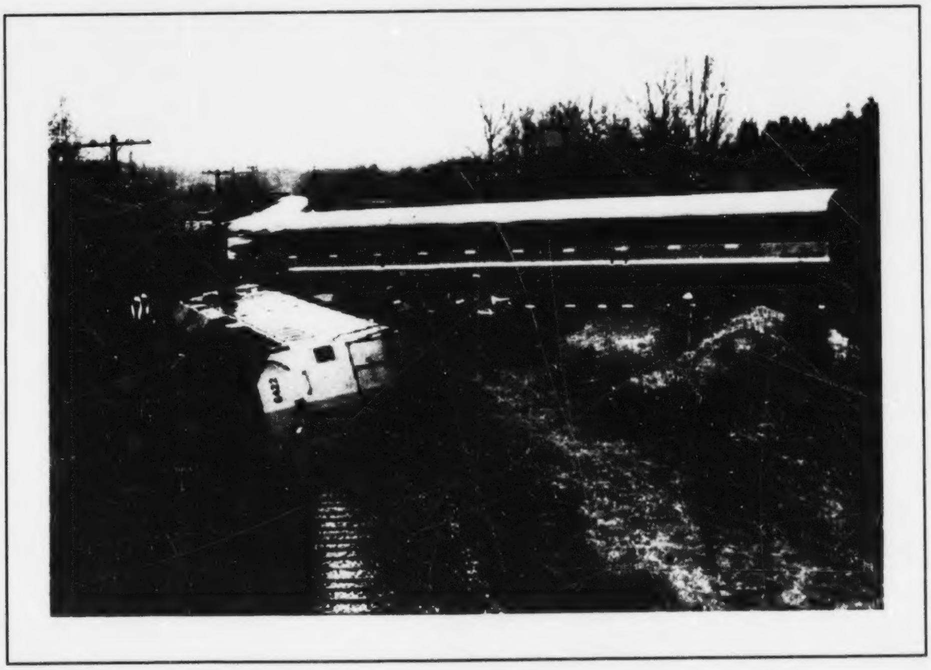
Bureau de la Sécurité des Transports du Canada

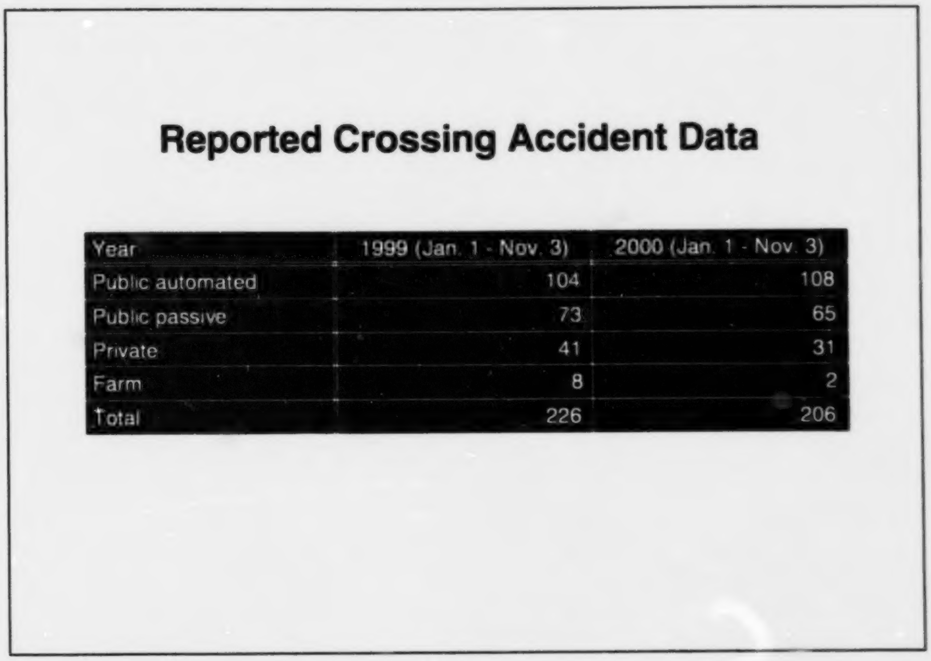
- Mandated by CTAISB Act and regulations
- Voluntary
- Securitas

P. LINE-DO NOT CROSS



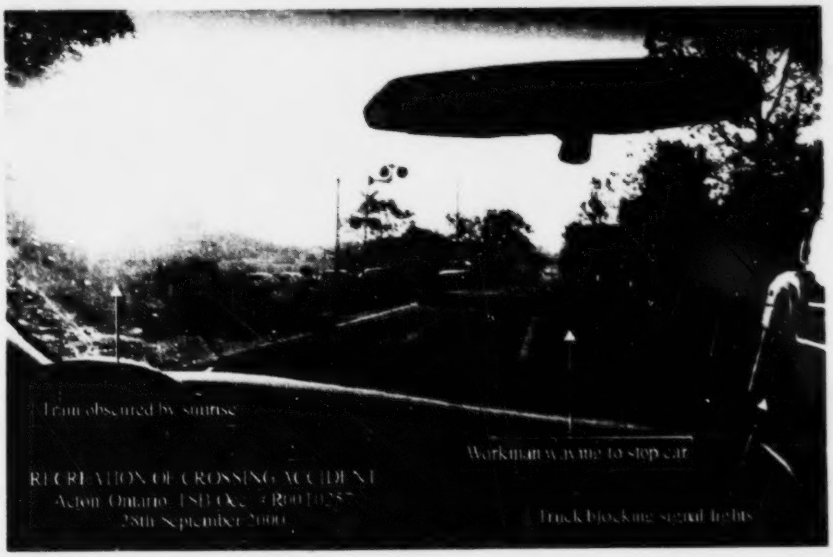
Persons using crossing do so at their own risk
Quiconque s'en sert le fait à ses propres risques
CN RAIL
STOP
ARRÊT
DANGER
STOP
HIGH
SPEED TRAINS
USE EXTREME CAUTION WHEN CROSSING TRACKS





Reported Crossing Accident Data

Year	1999 (Jan. 1 - Nov. 3)	2000 (Jan. 1 - Nov. 3)
Public automated	104	108
Public passive	73	65
Private	41	31
Farm	8	2
Total	226	206


Train obscured by sunrise
Workman waving to stop car
Truck blocking signal lights

RECREATION OF CROSSING ACCIDENT
Acton, Ontario, TSB Occ. # R00T0257
28th September 2000

Transportation Safety Board
of Canada

Bureau de la sécurité des
Transports du Canada

Grade crossing accidents:

Thank you

Questions?

Occurrence Data: an Integrated Approach to Data Integrity and Accessibility

Marc Fortin
Transport Canada, Occurrence Data, Analysis and Reports Division/
Transports Canada, Données sur les événements, de l'analyse et des rapports
Ottawa, Ontario

ABSTRACT

Transport Canada (TC) is developing a multimodal data warehouse that will incorporate information from a variety of sources, both internal and external to the department. It will include occurrence data, activity data, and technical inspection data. The goal is to integrate data from as many sources as possible and to make it readily available to all stakeholders, in a cooperative effort to improve transportation safety. This paper outlines the data sources involved, the accomplishments to date, the challenges to be met, and the hopes for the future.

RÉSUMÉ

Transports Canada (TC) est à constituer un dépôt de données multimodales puisées à diverses sources, tant à l'intérieur qu'à l'extérieur du Ministère. Il s'agira de données sur les incidents, sur l'activité de transport et sur les inspections techniques. Le but de ce projet est d'intégrer les données du plus grand nombre possible de sources et de les rendre facilement accessibles à tous les intervenants, dans un effort concerté pour améliorer la sécurité dans les transports. Cette communication présente les sources de données mises à contribution, les réalisations à ce jour, les défis qui se posent et les espoirs pour l'avenir.

TRANSPORT CANADA (TC) is developing a multimodal data warehouse that will incorporate information from a variety of sources, both internal and external to the department. It will include occurrence data, activity data, and technical inspection data.

TC DATA WAREHOUSE

Creation of the data warehouse will involve:

- Identifying data sources and acquiring access to the source information housed both in TC and with external stakeholders
- Reviewing the data to ensure that only quality data will reside in the data warehouse
- Implementing ETL – extraction, transformation, and loading (80 percent of the work)

Many issues, such as the compatibility of data from different sources, require review. The data integrity assessment will address incomplete, missing, inaccurate, and inconsistent data. Once the data has been transformed, the information will be ready for dissemination to users.

RAIL GRADE CROSSING REPOSITORY

A number of data sources related to the Rail-Highway Grade Crossing Research Program have been identified. Access to these sources from within TC or from external stakeholders will require agreement from all parties to share their information. Although some data are already available, TC is seeking information from other sources, such as carriers, coroner reports, and police reports. Tracking down jurisdictions is a significant undertaking.

As all of these sources were developed independently, the challenge will be to find ways to link the information and to ensure data integrity. Where gaps in the data are noted, other sources will be looked at to fill these gaps. The developers will also need to have a comprehensive understanding of reporting criteria from the different sources.

For data dissemination, different tools will be assessed to determine those best suited for user input and queries. The interface for reports and front-end queries will be designed to be user-friendly.

In the data-warehousing initiative, TC is working with the various jurisdictions to study their different reporting criteria and data capture methods. The system development will involve linking provincial and federal occurrences and developing built-in data integrity to ensure complete and consistent information. All inconsistent or questionable data will be flagged and reviewed by a data specialist before being loaded All provinces, even those that do not capture information electronically, will be able to enter their occurrence information directly into a centralized database.

ACCOMPLISHMENTS

Transport Canada, Occurrence Data, Analysis and Reports Division has acquired access to TSB occurrence data and a link between TC Road Safety crossing information and TSB crossing accident data has been established. This link has brought to light a number of data concerns and inconsistencies. An interface will be developed to allow TC to add information where gaps exist. Road data comes from the Collision Reporting Form completed by the police force. The federal-provincial initiative will capture provincial rail occurrence data that is not reported to the TSB. All provinces are participating in this initiative. IRIS (crossing inventory data) is currently being reviewed for completeness and quality. This database, which contains details on Canadian crossings, will aid in benchmarking crossing accident data. Differences in reporting criteria exist and lack of location data are making the linking process extremely difficult.

CHALLENGES

The federal-provincial initiative has highlighted many jurisdictional differences in reporting across the country. Some of the provinces have well-developed systems while others are without an accident reporting database. A major challenge has been defining common data elements and definitions.

Industry participation is key. The carriers have a wealth of valuable occurrence information that would complement other source information. Data sources sometimes contain very different information that cannot be linked or similar information with very different nomenclature. For a variety of reasons, organizations may restrict data access. Sources often lack key information, particularly causal data, or identify such information as non-shareable.

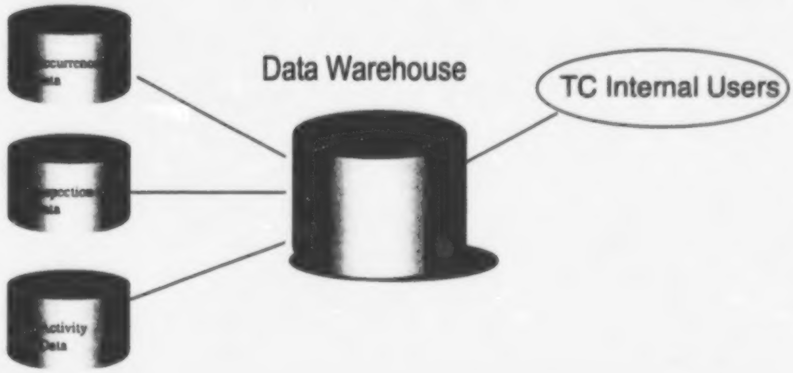
FUTURE DIRECTIONS

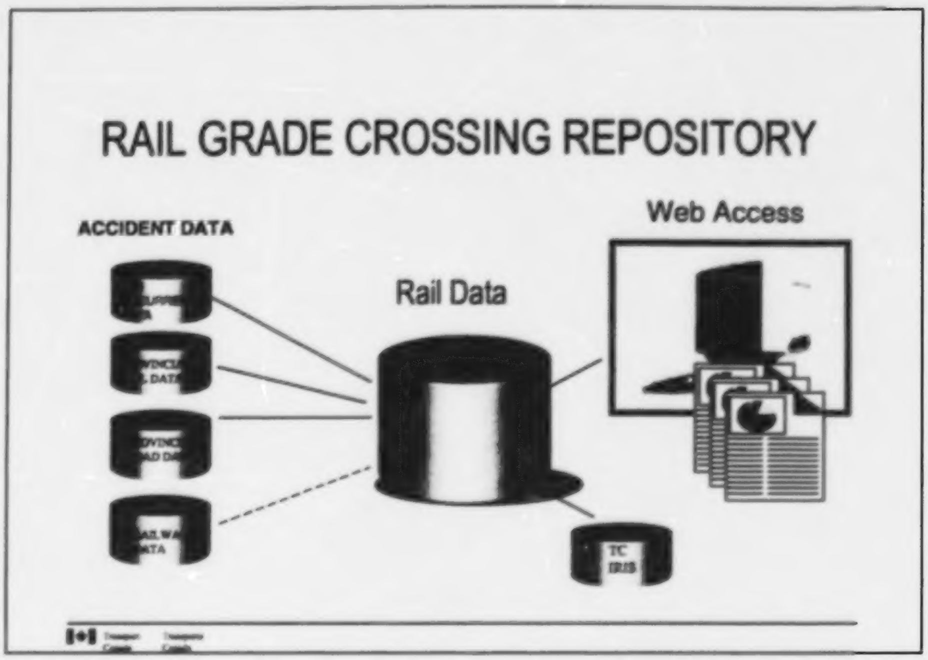
Technology today allows users to access many data sources, but what is needed is the culture or will to promote the sharing of information for safety purposes. A wealth of information is available, but it remains a challenge to obtain access to some of these sources. We must identify the critical gaps and seek strategies to address them. If all parties shared their information we could have a comprehensive data repository to aid in the reduction of occurrences. Today's tools would allow users to query the data using Web technology, providing access to all. As it is often extremely difficult to compile information due to differences, we are working toward standardizing the terminology. This standardization will assist in data interpretation and manipulation. With the participation of all parties we can achieve our goal of a central data repository of rail grade crossing accidents.

Occurrence Data:
An Integrated Approach to Data Integrity and Accessibility

Rail-Highway Grade Crossing Workshop
Presented by Marc Fortin
Nov. 15, 2000

TC DATA WAREHOUSE


ccurrenc
ata
spection
ata
Activity
Data
Data Warehouse
TC Internal Users

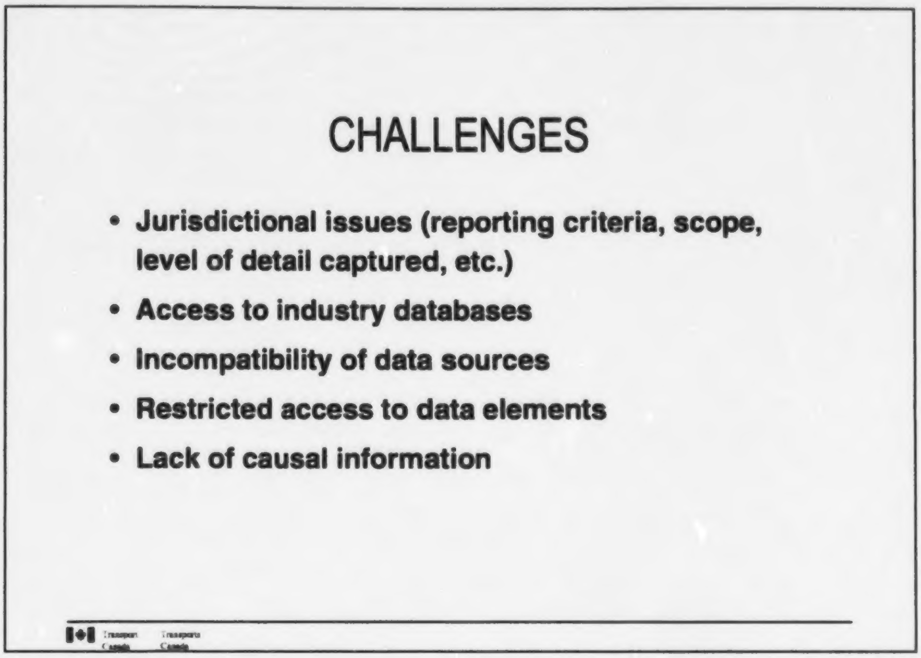


RAIL GRADE CROSSING REPOSITORY

ACCIDENT DATA
Rail Data
Web Access
TC
IRIS

ACCOMPLISHMENTS

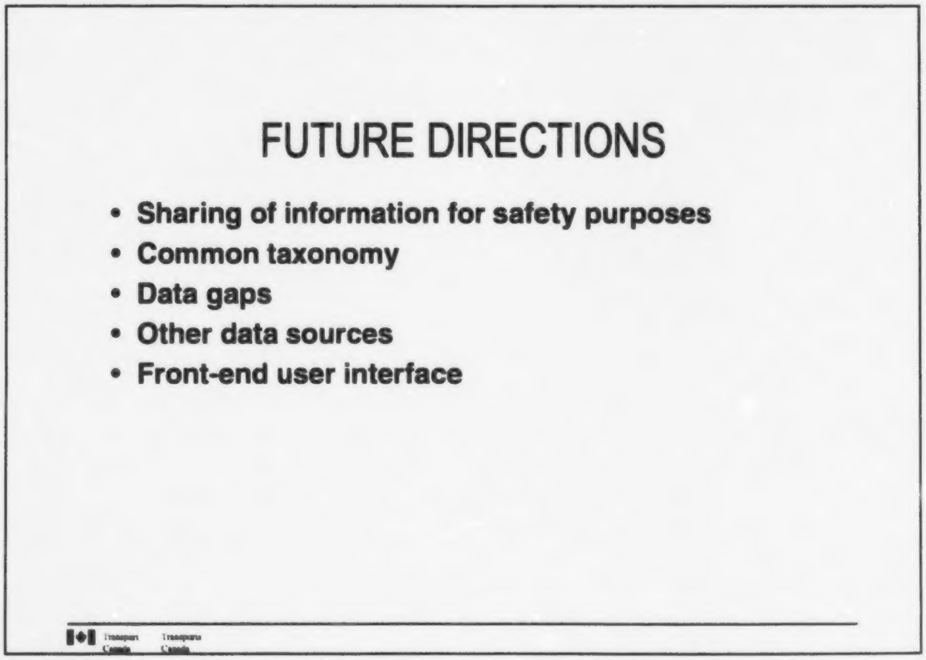
- **Access to TSB rail occurrence data**
- **Federal-Provincial project well under way**
- **Road Safety (TC) crossing information**
- **IRIS Integrated Rail Information System (rail crossing data inventory) working on the quality assurance processes**



CHALLENGES

- **Jurisdictional issues (reporting criteria, scope, level of detail captured, etc.)**
- **Access to industry databases**
- **Incompatibility of data sources**
- **Restricted access to data elements**
- **Lack of causal information**

Transport Canada Transports Canada



FUTURE DIRECTIONS

- **Sharing of information for safety purposes**
- **Common taxonomy**
- **Data gaps**
- **Other data sources**
- **Front-end user interface**

Transport Canada Transports Canada

Analysis of Collision Data: Expectations and Reality

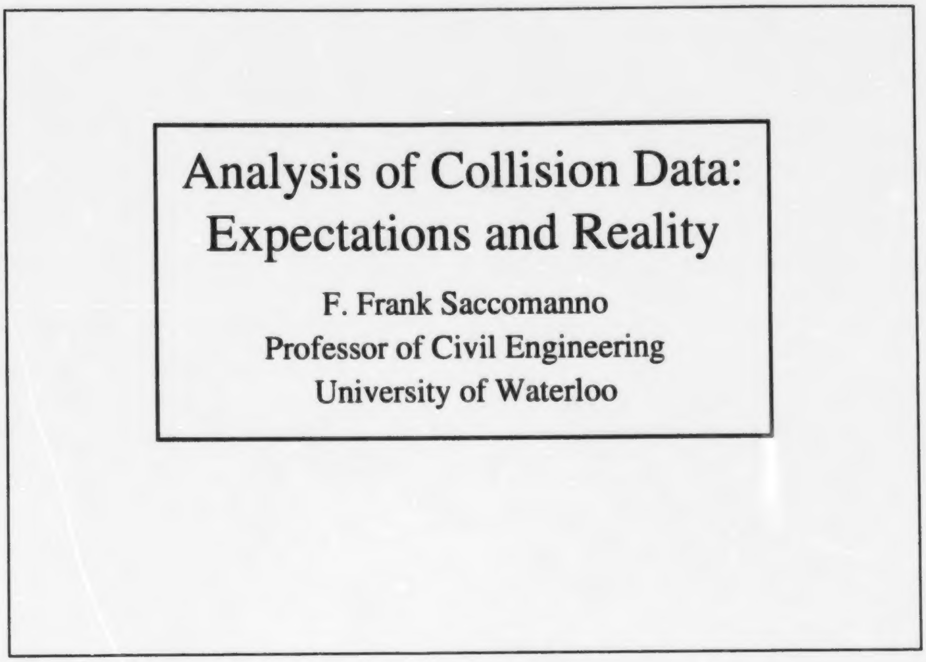
Frank Saccomanno
University of Waterloo, Institute for Risk Research
Waterloo, Ontario

ABSTRACT

Decision-makers are constantly searching for ways to reduce the high human and economic costs of accidents. Often funds spent on safety countermeasures tend to be driven more by perception and public reaction than by an objective appreciation of the risks involved. This presentation describes the basic components of an integrated road accident model for guiding decisions on safety intervention – whether such intervention is warranted and what form it should take. The approach is risk-based, taking into account both the potential for accidents and their severity. The development and evaluation of safety countermeasures are carried out using a micro-level systems dynamics model. An application of this model to Ontario road accident data is discussed. While the focus of the presentation is on reducing road accidents, it is argued that the approach could be applied to improve safety for rail-highway grade crossings.

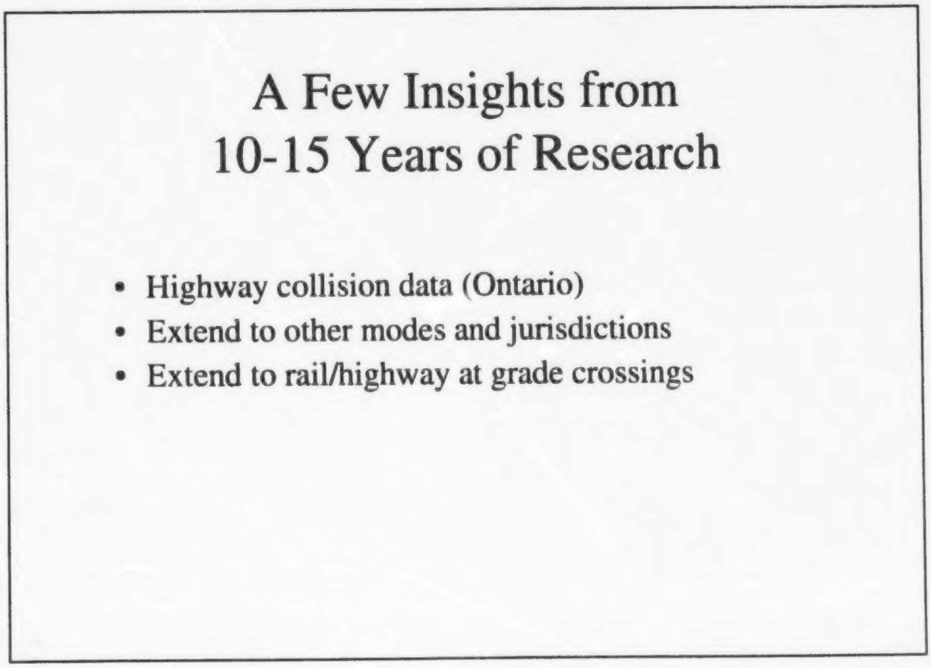
RÉSUMÉ

Les décideurs sont constamment à la recherche de moyens de réduire les coûts humains et économiques des accidents. Souvent, les mesures prises et les montants dépensés pour promouvoir la sécurité sont davantage dictés par des perceptions et par la réaction du public que par une évaluation objective des risques. Cette présentation décrit les éléments essentiels d'un modèle intégré d'accidents routiers susceptible de faciliter les prises de décision touchant les interventions en matière de sécurité – une intervention donnée est-elle justifiée et quelle forme devrait-elle prendre? Il s'agit d'une démarche fondée sur l'analyse des risques, qui tient compte à la fois de la possibilité que survienne un accident et, le cas échéant, de sa gravité. La mise au point et l'évaluation de mesures propres à favoriser la sécurité se fondent sur la modélisation dynamique de microsystèmes. Le document expose l'application de ce modèle aux données ontariennes sur les accidents routiers. Même si la présentation porte surtout sur les accidents routiers, la même démarche, croit-on, pourrait servir à accroître la sécurité aux passages à niveau.



Analysis of Collision Data: Expectations and Reality

F. Frank Saccomanno
Professor of Civil Engineering
University of Waterloo



A Few Insights from 10-15 Years of Research

- Highway collision data (Ontario)
- Extend to other modes and jurisdictions
- Extend to rail/highway at grade crossings

Goal of Transportation Safety Research

To reduce accidents and their consequent damages (i.e., deaths, personal injuries, and property damage, etc.)

How Important are Road Accidents?

U.S.A.	60,000 deaths/year	(1990)
	Estimated cost U.S.$137 billion	
Ontario	About 1000 deaths/year	(1997)
	Estimated cost U.S.$9 billion	(1996)

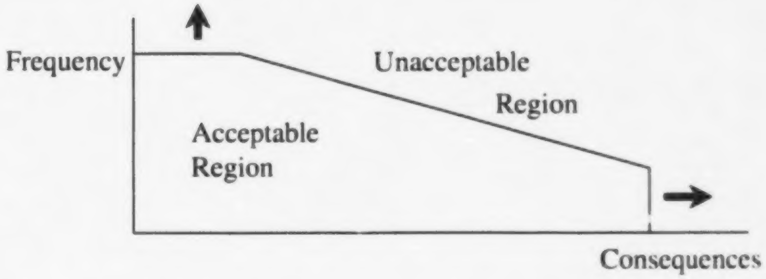
These are direct costs and do not include costs of traffic delays and environmental impacts.

Steps for Reducing Accident Risk

- Identify locations where risk of accidents is unacceptable (risk = prob. * conseq.)
- Investigate reason for this risk. How many different types of accidents take place at this location?
- Develop and evaluate safety countermeasures

Locations with Unacceptable Risk

Define risk in terms of frequency and consequences


Frequency
Unacceptable
Region
Acceptable
Region
Consequences

Focus: Frequency of Accidents

Simple Risk Tolerance Criterion

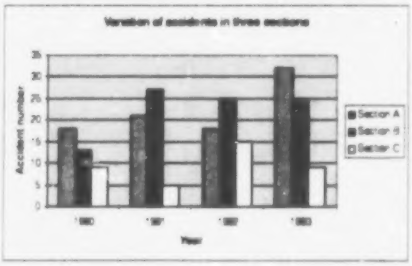
Risk Unacceptable if:

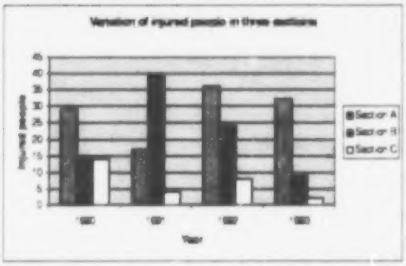
Observed Accidents ***GT*** Predicted + 1 SD

Black Spot

How to designate?

Use of Historical Accident Data





Section A:	401 From Lancaster, Hwys 2-34 IC-814 to Summerstown Rd IC-804
Section B:	401 From Dickinson Rd IC-770 to Osnabruck-Williamsburg TWP
Section C:	401 From Hwy 137 IC-661 to Reynolds Rd IC-659-Leeds Rd 3

Controls on Accident Potential

- Road geometry
- Traffic composition
- Vehicle attributes
- Weather conditions
- Light conditions
- Driver conditions

Accident Prediction Models

Purpose: Control for mix of factors that explain variation in accidents at given location and point in time. Smooth out fluctuations in historical accident data.

Approaches used

- Multivariate linear regression
- Poisson regression
- Empirical Bayesian model

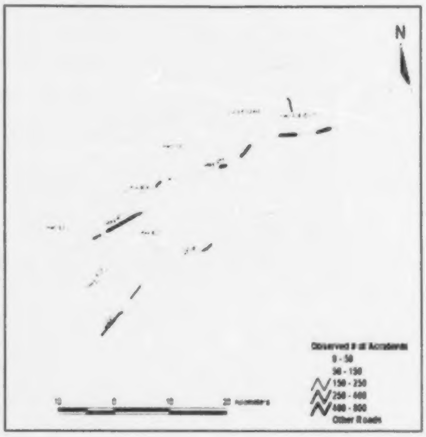
Accident Prediction Models (cont'd)

- Cannot know everything about a given location at a given point in time
- Statistical models poorly specified
- Rationale for EB
- BS identification: Application to 400 series highways in Ontario
- Comparing Poisson and EB models

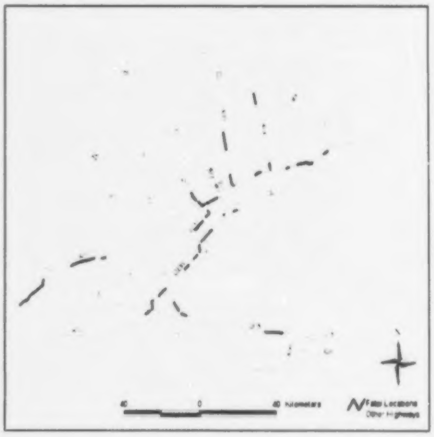
Ontario 400-Series Highway BS (Poisson Model Prediction)

N
Observed # of Accidents
0 - 50
50 - 100
100 - 200
200 - 400
400 - 800
Other Roads

Ontario 400-Series Highway BS (EB Model Prediction)


N
Observed # of Accidents
0 - 50
50 - 150
150 - 250
250 - 400
400 - 800
Other Roads
10
0
10
20 Kilometers

Fatal Accident Locations 1992 (400-Series Highways)

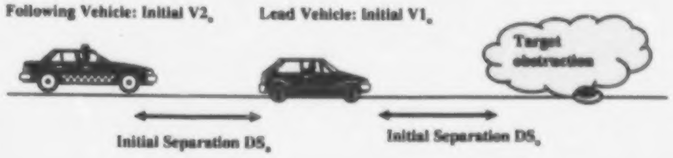

40
0
40 Kilometers
Fatal Locations
Other Highways

What Next?

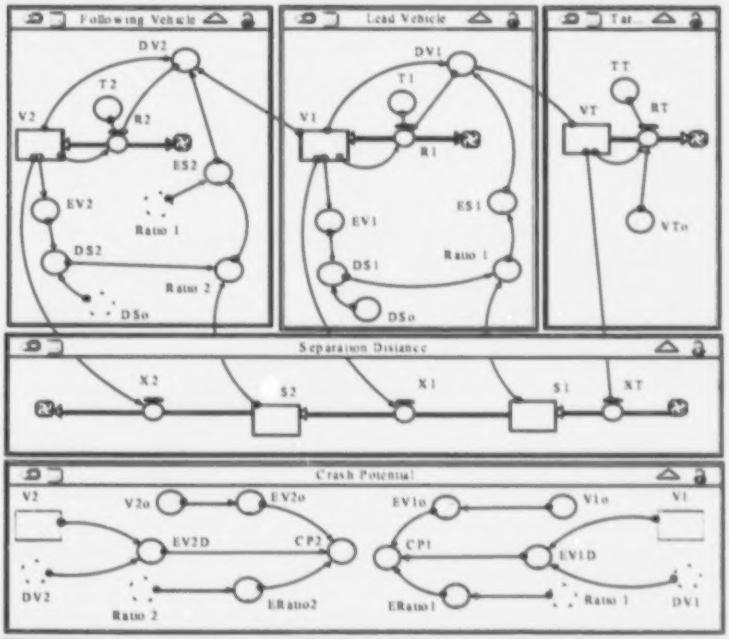
- Established high risk locations (BS)
- What causes this risk?
- How can these locations be made safer?
- Develop and evaluate safety countermeasures

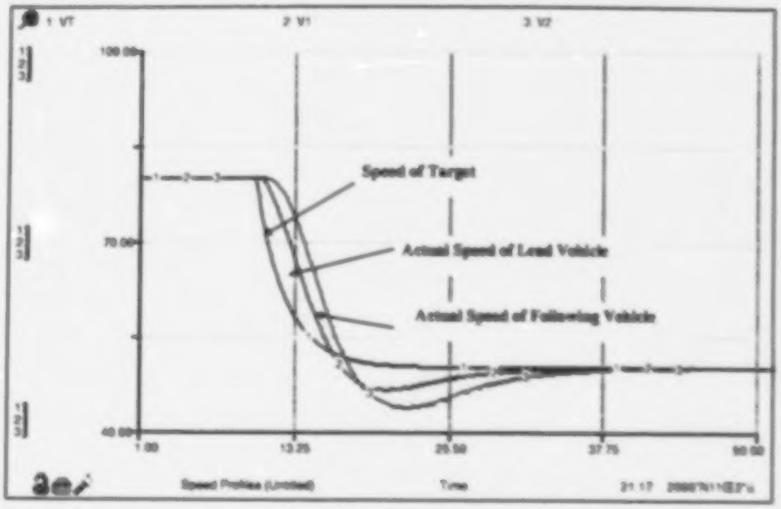
Assessing Countermeasures

- Before and after method using accident prediction models
  - Model poorly specified
  - Statistical limitations
- Micro-level analysis of accident profiles (Systems Dynamics Approach)

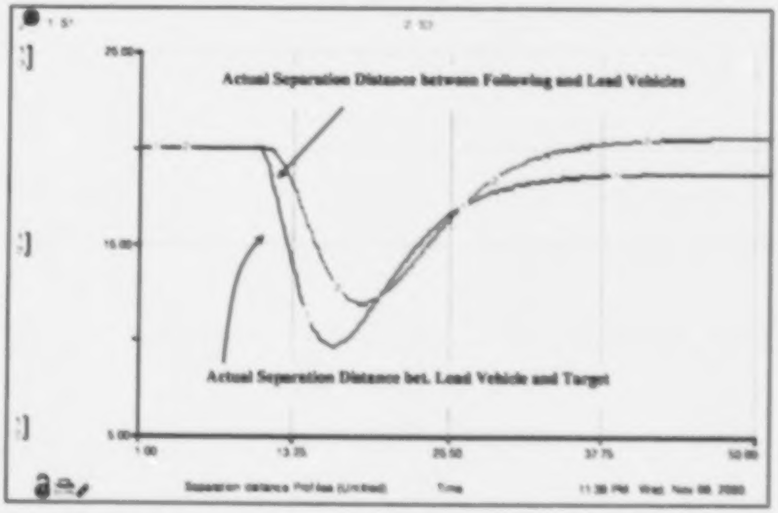

Following Vehicle: Initial $V2_o$
Lead Vehicle: Initial $V1_o$
Target obstruction
Initial Separation DS_o
Initial Separation DS_o

- Driver and road environment normal (assumption)
- Desired speed of LV/FV = f (target and LV speed, desired separation distance, road condition)
- Actual speed of LV/FV = f (initial speed, time, road condition)
- Desired sep. distance = f (actual speed, road condition)
- Actual sep. distance = f (speed differential, time, road condition)
- Crash potential = f (actual speeds, speed differentials, actual separation distance)

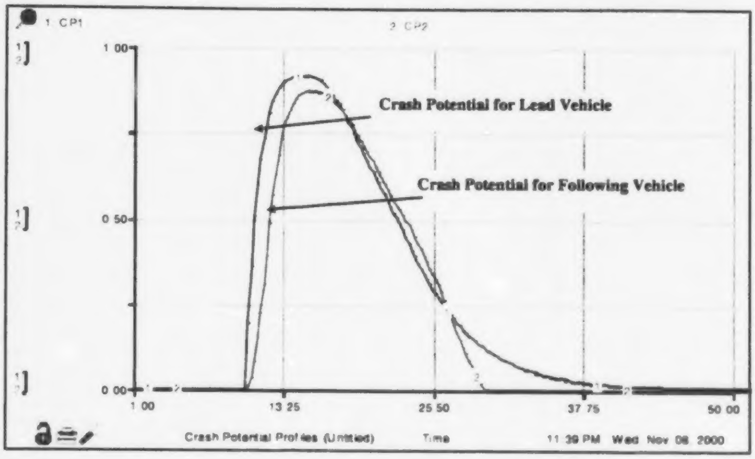

Following Vehicle
DV2
T2
V2
R2
ES2
EV2
Ratio 1
DS2
Ratio 2
DSo
Lead Vehicle
DV1
T1
V1
R1
ES1
EV1
Ratio 1
DS1
DSo
Tar...
TT
VT
RT
VTo
Separation Distance
X2
S2
X1
S1
XT
Crash Potential
V2
V2o
EV2o
EV2D
CP2
DV2
Ratio 2
ERatio2
EV1o
V1o
V1
CP1
EV1D
ERatio1
Ratio 1
DV1



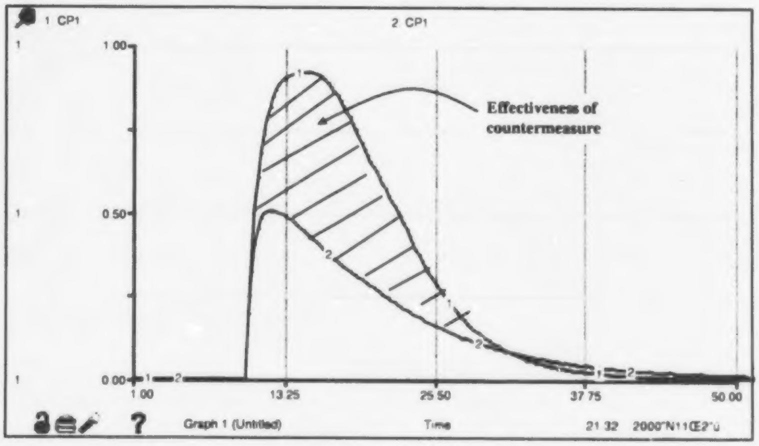
Speed profiles of target, lead, and following vehicles



Separation distance profiles of lead and following vehicles

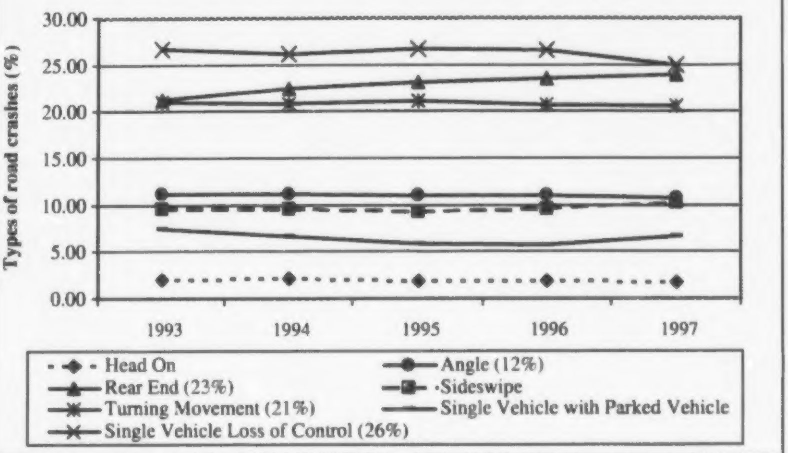


Crash potential profiles of lead and following vehicles

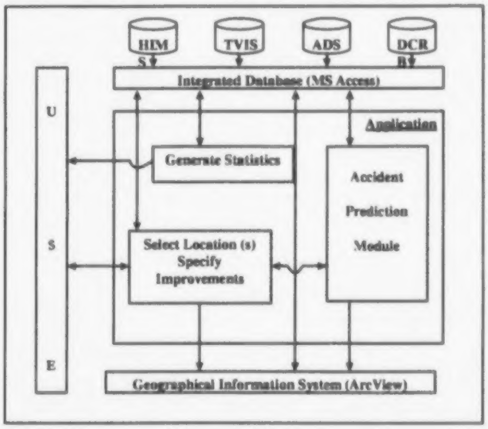


Crash potential profiles before and after countermeasure

Distribution of crash types by year



GIS Platform for Accident Analysis and Prediction


HIMS
TVIS
ADS
DCRB
Integrated Database (MS Access)
U
S
E
Application
Generate Statistics
Accident Prediction Module
Select Location (s) Specify Improvements
Geographical Information System (ArcView)

Conclusions

- Identification of high risk BS
- Micro-level analysis of accident profiles at BS locations
- Development and evaluation of safety countermeasures
- Link to GIS referencing system
- Relevance to rail-highway grade crossing accidents

A Human Factors Analysis of Rail-Highway Grade Crossing Accidents

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University of Calgary, Department of Psychology
Cognitive Ergonomics Research Laboratory
Calgary, Alberta

R. Dewar
Western Ergonomics
Calgary, Alberta

SUMMARY

In Canada between 1989 and 1998, an average of 55 people were killed each year from rail-highway crossing accidents (TSB, 1999). Over the same period, the number of fatalities, injuries, and total accidents declined slightly. The reasons for the reduction in accidents and fatalities from 1989 to 1998 are largely unknown. The dramatic drop in injuries between 1992 and 1993 indicates a change in classification criteria. In 1993, the TSB changed the classification from all injuries to only serious injuries. Passive (i.e., standard reflectorized crossing signs) and active (i.e., flashing lights and bells) crossings have the most frequent accidents and fatalities (Coghlan, 2000). In addition, pedestrian accidents have increased in the past five years. Fournier and Turgeon (2000) identify two primary causes of grade crossing accidents in Quebec: 1) failure to heed signals; and 2) difficulties in the detection and interpretation of signals.

Identification and elimination of these accident precursors is essential to the prevention of similar accidents. For example, the NTSB (1998) identified a number of common safety issues associated with passive grade crossings, including:

- the adequacy of existing warning systems to alert the driver to the presence of a passive crossing and an approaching train
- railroad and track conditions that affect a driver's ability to detect the presence of an oncoming train
- behavioural factors that affect a driver's ability to detect the presence of an oncoming train
- the need for improved signage at private passive grade crossings

Whether or not these same safety issues are equally important in Canada is an open question that will be addressed by proposed research.

Intelligent transportation system (ITS) technology may address one vehicle-train accident precursor. In particular, in-vehicle safety advisory and warning systems (IVSAWS) present time-critical information about upcoming hazards (e.g., railroad crossings) and potential route difficulties (e.g., the approach of emergency vehicles). Within IVSAWS applications, in-vehicle train warnings (ITW) may lessen the frequency and severity of grade crossing accidents. Analysis of vehicle-train accidents

reveals that drivers do not always see approaching trains, passive warnings (e.g., crossbuck signs), or active warnings (e.g., lights and bells) prior to reaching crossings (Åberg, 1988; Lerner et al., 1990). ITWs have the potential to provide redundant traffic sign and signal information and orient drivers to approaching trains. ITW system reliability is another concern (Chugh & Caird, 1999).

This presentation describes a project supported by the Transportation Development Centre, the Canadian Transportation Safety Board, and the University of Calgary. The objectives are to develop a taxonomy of factors contributing to crashes, to apply this taxonomy to TSB data samples, and to assess how effectively existing and proposed countermeasures offset the contributing factors.

References

Åberg, L. (1988). Driver behavior at flashing-light, rail-highway crossings. *Accident Analysis and Prevention*, 20(1), 59–65.

Chugh, J. S., & Caird, J. K. (1999). In-vehicle train warnings (ITW): The effect of reliability and failure type on driver perception response time and trust. *Proceedings of the 43rd Annual Meeting of the Human Factors and Ergonomics Society Meeting* (pp. 1012–1016). Santa Monica, CA: Human Factors and Ergonomics Society.

Coghlan, M. (2000). Statistics: Do they tell the whole story? *Proceedings of the workshop on rail-highway grade crossing research, Ottawa, Ontario, 18 November, 1999* (Rep. No. TP 13536) (pp. 1–17). Montreal, Canada: Transportation Development Centre, Transport Canada.

Fournier, G., & Turgeon, R. (2000). Nuts and bolts of crossings and safety systems. *Proceedings of the workshop on rail-highway grade crossing research, Ottawa, Ontario, 18 November, 1999* (Rep. No. TP 13536) (pp. 43–72). Montreal, Canada: Transportation Development Centre, Transport Canada.

Lerner, N. D., Ratte, D., & Walker, J. (1990). *Driver behavior at rail-highway crossings* (Rep. No. FHWA-SA-90-008). Washington, D.C.: U.S. Department of Transportation, Federal Highway Administration.

National Transportation Safety Board (1998). *Safety study: Safety at passive grade crossings, Volume 1: Analysis* (PB98-917004, NTSB/SS-98/02). Washington, D.C.: NTSB.

Transportation Safety Board (1999). *Table 5: Crossing accidents and related casualties by province 1989-1998.* [On-line]. Available: http://bst-tsb.gc.ca/ENG/

SOMMAIRE

Au Canada, de 1989 à 1998, les accidents aux passages à niveau ont fait 55 morts par année en moyenne (BST, 1999). Au cours de la même période, le nombre de tués et de blessés, ainsi que le nombre total d'accidents, ont légèrement diminué. On ne connaît pas toutes les raisons de ce déclin. Mais la baisse brutale du nombre de blessés de 1992 à 1993 est due à un changement des critères de classification. En effet, depuis 1993, le BST ne consigne que les blessures graves. C'est aux passages à niveau non automatisés (dotés d'écriteaux réfléchissants classiques) et automatisés (équipés de feux clignotants et de cloches) que l'on enregistre le plus grand nombre d'accidents et de tués (Coghlan, 2000). De plus, les accidents mettant en cause des piétons ont augmenté au cours des cinq dernières années. Fournier et Turgeon (2000) attribuent les accidents aux passages à niveau au Québec à deux grandes causes : 1) le non-respect des signaux d'avertissement; et 2) la difficulté à détecter et à interpréter les signaux.

Il est essentiel, pour prévenir d'autres accidents semblables, de cerner et d'éliminer ces facteurs. Par exemple, le NTSB (1998) a mis au jour certains facteurs de risque courants associés aux passages à niveau non automatisés, dont :

- dispositifs d'avertissement existants mal adaptés à leur fonction, soit prévenir le conducteur de la présence d'un passage à niveau non automatisé et de l'approche d'un train
- conditions de voie qui altèrent la capacité d'un conducteur à détecter l'arrivée d'un train
- facteurs comportementaux qui altèrent la capacité d'un conducteur à détecter l'arrivée d'un train
- signalisation défaillante aux passages à niveau privés.

Ces problèmes ont-ils la même acuité au Canada qu'aux États-Unis? Voilà une des questions sur lesquelles se penchera la recherche proposée.

Les systèmes de transports intelligents (STI) peuvent éliminer un des facteurs de risque d'accident véhicule-train. Ainsi les systèmes embarqués d'information et d'avertissement (IVSAWS, *in-vehicle safety advisory and warning systems*) transmettent au conducteur une information cruciale sur l'approche de dangers (p. ex., les passages à niveau) et sur les situations pouvant créer un problème sur la route (p. ex., l'approche d'un véhicule d'urgence). Parmi les applications IVSAWS, l'avertissement en cours de route de l'approche d'un train (ITW, *in-vehicle train warning*) peut réduire la fréquence et la gravité des accidents aux passages à niveau. Ainsi, l'analyse des collisions véhicule-train révèle que les conducteurs ne voient pas toujours les trains qui approchent, ni les signaux d'avertissement, qu'ils soient automatisés (feux clignotants et cloches) ou non automatisés (croix d'avertissement), avant d'arriver au passage à niveau (Åberg, 1988; Lerner et coll., 1990). Les dispositifs ITW visent à transmettre une information et des signaux redondants et à attirer l'attention des conducteurs sur l'approche d'un train. La fiabilité de ces systèmes est une tout autre question (Chugh & Caird, 1999).

Cette présentation porte sur un projet mené sous l'égide du Centre de développement des transports, du Bureau de la sécurité des transports du Canada et de l'Université de Calgary. Ce projet a pour objectifs d'établir une taxonomie des facteurs d'accidents, d'appliquer cette taxonomie à des

échantillons de données du BST et d'évaluer l'efficacité des mesures existantes et proposées à neutraliser ces facteurs.

Références

Åberg, L. (1988). Driver behavior at flashing-light, rail-highway crossings. *Accident Analysis and Prevention*, 20(1), 59-65.

Bureau de la sécurité des transports au Canada (1999). *Tableau 5 : Accidents aux passages à niveau et nombre de victimes par province 1989-1998.* [En ligne]. Adresse : http://www.tsb.gc.ca/Francais/

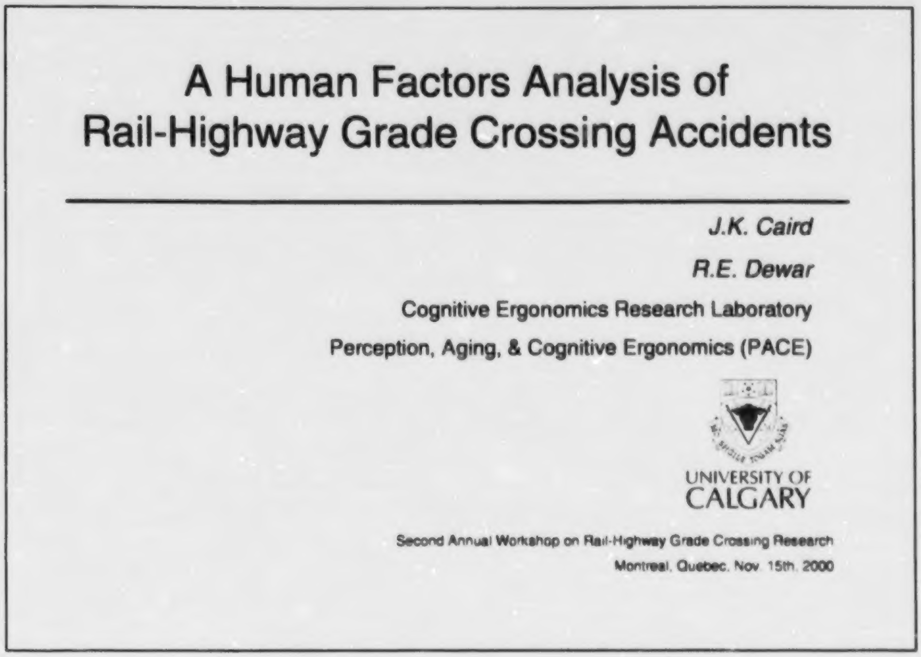
Chugh, J. S., & Caird, J. K. (1999). In-vehicle train warnings (ITW): The effect of reliability and failure type on driver perception response time and trust. *Proceedings of the 43rd Annual Meeting of the Human Factors and Ergonomics Society Meeting* (pp. 1012-1016). Santa Monica, CA: Human Factors and Ergonomics Society.

Coghlan, M. (2000). Statistics: Do they tell the whole story? *Compte rendu de l'atelier sur la recherche sur les passages à niveau, Ottawa, Ontario, 18 novembre 1999* (TP 13536) (p. 1-17). Montréal, Canada. Centre de développement des transports, Transports Canada.

Fournier, G., & Turgeon, R. (2000). Nuts and bolts of crossings and safety systems. *Compte rendu de l'atelier sur la recherche sur les passages à niveau, Ottawa, Ontario, 18 novembre 1999* (TP 13536) (p. 43-72). Montréal, Canada. Centre de développement des transports, Transports Canada.

Lerner, N. D., Ratte, D., & Walker, J. (1990). *Driver behavior at rail-highway crossings* (Rep. No. FHWA-SA-90-008). Washington, D.C.: U.S. Department of Transportation, Federal Highway Administration.

National Transportation Safety Board (1998*). Safety study: Safety at passive grade crossings, Volume 1: Analysis* (PB98-917004, NTSB/SS-98/02). Washington, D.C.: NTSB.



A Human Factors Analysis of Rail-Highway Grade Crossing Accidents

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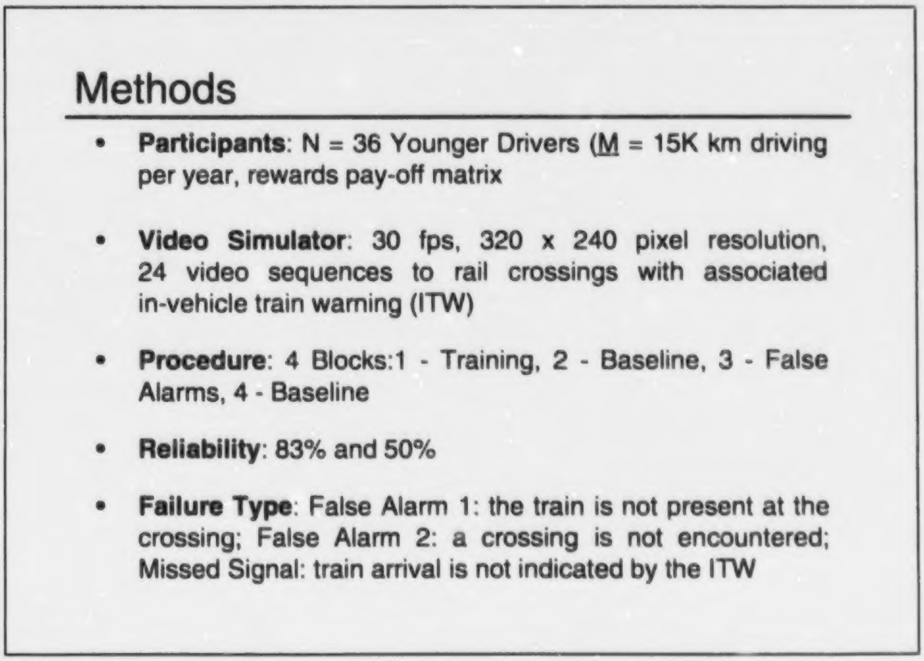
Second Annual Workshop on Rail-Highway Grade Crossing Research
Montreal, Quebec, Nov. 15th, 2000



Methods

- **Participants**: N = 36 Younger Drivers (M = 15K km driving per year, rewards pay-off matrix
- **Video Simulator**: 30 fps, 320 x 240 pixel resolution, 24 video sequences to rail crossings with associated in-vehicle train warning (ITW)
- **Procedure**: 4 Blocks:1 - Training, 2 - Baseline, 3 - False Alarms, 4 - Baseline
- **Reliability**: 83% and 50%
- **Failure Type**: False Alarm 1: the train is not present at the crossing; False Alarm 2: a crossing is not encountered; Missed Signal: train arrival is not indicated by the ITW

Results

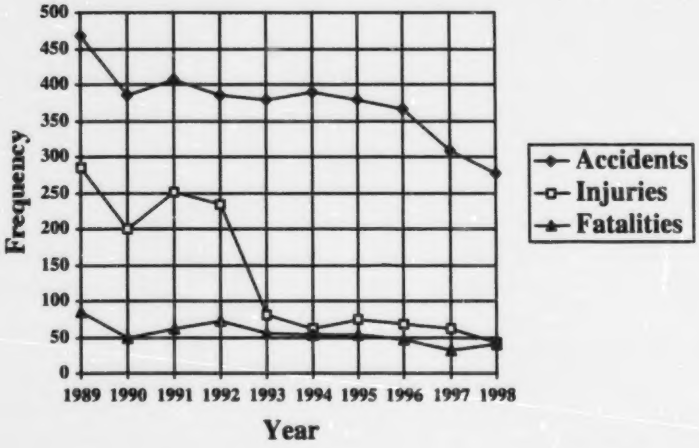
- **Baseline Measures**: Perception Response Time (PRT) = 1.8 s (SD = 0.8s) PRTs in Blocks 1 and 2 were relatively stable
- **Failure Type**: False Alarm 1: No train, higher PRT. Missed Signals (no train ITW) PRT significantly decreased
- **Reliability**: Three-way interaction of failure type (3) x reliability (2) x Event (6). Failure Type (3) x Event (6) was significant for 50% condition. Simple effects for False Alarm 1 and 2 were significant
- **Trust**: Main effect of reliability was significant

Discussion

- Manipulations of reliability and failure type affected PRT and trust
- ITWs that were consistent with the true state of the traffic environment transiently affected responses at train crossings
- Participants responded sooner to ITWs after missed signals
- Driver trust in ITWs was sensitive to manipulations of reliability, but not necessarily failure type

Human Factors Analysis and Taxonomy of Rail-Highway Grade Crossing Incidents

- Collaborative Partners: Transportation Development Centre, Transportation Safety Board, University of Calgary
- University Research Team: Dr. Caird, Dr. Dewar, Reana Saraceni, Chris Edwards
- Project Objectives:
  - Develop a human factors taxonomy of crash contributors based on international research literature
  - Apply the taxonomy to sampled cases from TSB data
  - Analyse accident contributors for fit with existing and future countermeasures
- Final Deliverable: TDC technical report



Canadian rail-highway crossing accidents by related casualties
(Total in public crossings in January 1999 was 22,424)
Adapted from Transportation Safety Board (1999), Table 5, [On-line] w.w.w.tsb.cg.ca/ENG.

Failure Mode Analysis

- What incorrect actions can people do?
- What adverse result can arise from those incorrect actions?
- How can those actions be prevented from being completed?

Sanders (1994), p. 175

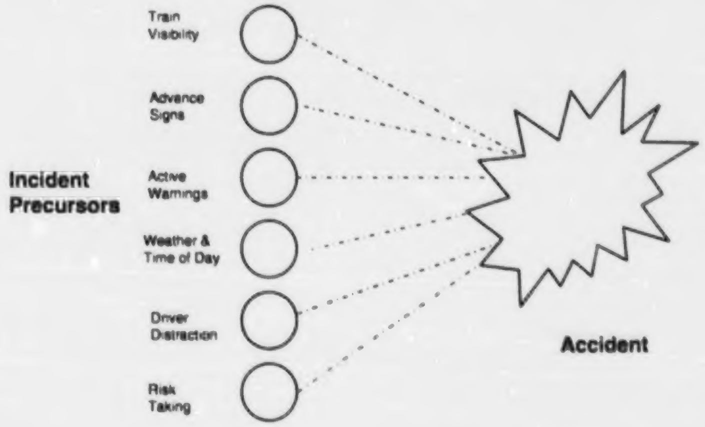
Driver Errors at Crossings

- Failure to detect a train at a passive or active crossing
- Inadequate slowing before entering a crossing
- Failure to sense or comprehend crossing signals or signs
- Failure to anticipate the actions and/or intentions of other drivers and pedestrians at the crossing
- The physical masking of trains by other vehicles, buildings, or vegetation

Driver Errors at Crossings (cont'd)

- Failure to coordinate travel within the crossing in accordance with the warning lights
- Weather or time of day visibility and road conditions
- Roadway or train track geometry limits sight distances
- Driver impairment due to loss of capability, illness, drugs, fatigue, or alcohol
- Driver distraction by internal or external factors

Human Factors Incident Analysis


Train Visibility
Advance Signs
Incident Precursors
Active Warnings
Weather & Time of Day
Driver Distraction
Risk Taking
Accident

Human Factors Issues in Rail-Highway Grade Crossings

- Accident Statistics
- Advance Warning Signs
- Grade Crossing Characteristics (e.g., crossbucks, traffic signals, crossing angle, pavement markings, etc.)
- Flashing Light Warnings
- Gated Crossings
- Roadway Variables

Human Factors Issues in Rail-Highway Grade Crossings (cont'd)

- Weather Conditions
- Train Variables
- Driver Factors (e.g., perception, decision-making, risk-taking)
- Countermeasures (e.g., conventional or ITS improvements to train, crossing, approach)

Database of Operation Lifesaver Information (*DOLI*)

Ranjan Kelly
RTRAN7
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ABSTRACT

In September 2000, a database system was completed for the Canadian railway safety awareness program Operation Lifesaver (OL). The Database of Operation Lifesaver Information (DOLI) was designed to enhance OL's ability to gather and analyse the information it requires to carry out its mandate in the area of railway crossing and trespasser safety. This presentation first provides a short background on the database project and its expected benefits. Key features of the database are then described. At the workshop a practical demonstration of the actual system was included.

RÉSUMÉ

En septembre 2000, un système de base de données a été élaboré à l'intention de l'Opération Gareautrain, un programme national de sensibilisation à la sécurité ferroviaire. Cette base de données a été conçue pour faciliter la tâche des responsables de l'Opération Gareautrain dans le regroupement et l'analyse de l'information dont ils ont besoin pour réaliser leur mandat, soit d'accroître la sécurité aux passages à niveau et de prévenir les intrusions sur les emprises ferroviaires. Dans un premier temps, sont brièvement exposés la genèse du projet de base de données et les avantages escomptés. Sont ensuite décrites les principales caractéristiques de la base de données. Les personnes présentes à l'atelier ont pu assister à une démonstration du système en vraie grandeur.

1. BACKGROUND

Operation Lifesaver (OL) is a railway safety program sponsored by government and the railways in Canada and the U.S. Its primary objective is to make the public and others aware of the dangers on and surrounding railway tracks. OL essentially addresses the education component of the "3 E" approach to crossing/trespasser safety: Engineering, Enforcement, Education.

OL carries out its many safety activities in a number of ways. One primary focus is their Presenter Program, whereby formally trained OL presenters give safety presentations at locations such as schools and transport organizations. What started out nearly 20 years ago as a limited number of reactive presentations annually to address critical highway-railway crossing locations, is now a full-blown, structured safety education program. It involves:

- Both crossing and trespasser problems
- Several hundred presenters
- Several thousand presentations and related activities
- Some 20 formal presentation types designed for specific audiences
- Numerous educational materials for distribution

The requirement for automated processing and data stores is guided by an organization's business. The following is a summary of the OL business in the context of its Presenter Program:

- Applicants wishing to become presenters first go through a formal screening process
- Those accepted have to undergo training to become certified as OL volunteers
- There are four categories of volunteers, each with specific certification requirements
- There are several formal presentation and activity types, aimed at different vocations and age groups
- Presenters ask OL for educational materials to distribute at OL events
- Information on presenters and presentations is collected by OL through forms
- The information is analysed by OL and its partners for monitoring/evaluating/planning

As a result of the above and the quantitative nature of the information, OL identified a need for a formal database, i.e., a structured approach to collecting and evaluating the acquired information. This would enable:

- Better analysis of problems and proposed solutions
- Better monitoring of the overall program
- Targeting of audiences and problem areas
- Improved planning of future initiatives
- Consideration of other needs (e.g., monitoring the inventory of OL education materials)

2. EXPECTED BENEFITS

The overall objective of the database is to improve OL's ability to gather and analyse information on presenters, presentations, and related materials; in more basic terms, to help OL answer the question (and target): *Who is presenting what to whom and where?*

Specifically the database will provide OL, the railways, and other parties interested in crossing and trespasser safety:

- *Better quality data* – from a system that will allow users to enter and maintain pertinent data (and consolidated OL, CN, and CP, and other railway data) in a timely, efficient, standardized, and reliable manner.

- *Improved response capability (ability to answer management queries with speed and confidence)* – from a system that will allow users to perform ad hoc and recurring data extractions efficiently.

- *Improved OL ability to monitor, evaluate, focus, and improve its safety efforts; and to gain the support of others for its messages and proposals* – through the use of a structured information base of relevant background data.

- *Easier comparison of OL performance with other Canadian and international safety programs and indicators* – through the ability to exchange data and to interface with other safety organizations using current computer technology.

- *Easier and less costly future expansions and interfaces with other systems* – through a database system, built within existing technological standards and supported by a comprehensive background documentation and specifications base.

3. DATABASE FEATURES

DOLI features include the following:

- A relational database platform (using *MS Access* software).

- Automated data entry for presenter and presentation information. Minimum typing is required, as most data items offer the user drop-down lists of items to choose from by pointing and clicking. One such list includes the names of some 25,000 municipalities in Canada; each municipality is further linked to one of 76 closest major cities to allow better regional analysis of the data. Other lists have been similarly designed to allow productive evaluations of the data. Furthermore, the data entry interface incorporates data record editing, monitoring, and searching.

- Menus for a varied number of query routines and some 35 hard copy reports. A flexible interface allows users to choose from several parameters – again through the use of drop-down lists. There are three categories of reports: listings of selected data elements of several records; statistical cross-tabulations; and the complete details on a single data record.

- On-line help in the form of user and technical reference documentation, complemented by hard copy manuals. The documentation also identifies procedural guidelines for data entry, maintenance, quality, and extraction, and associated rules, e.g., for data completeness, accuracy, consistency, and timeliness.

- External text-based data provision. Presenters can submit their presentation forms via e-mail or the OL website. The information is then downloaded by the OL user in text format.

- Monitoring of the presenter process. Application, training, and certification. A hierarchical user interface allows the entry, viewing, and querying of presenter and presentation information such that the data can be analysed in parallel.

- Consolidated OL, CN, and CP data, as well as data from other OL sponsoring agencies. The two largest sponsoring agencies, CN and CP, incorporate OL-related presentations and activities into their community service programs. The system allows the capture of data independently collected by CN and CP on OL presentations/activities involving presenters under their employment.

- Import and export ability for data transfer to and from OL. The system allows import of data via other interfaces and software, e.g., the Internet and MS Excel. System utilities also allow data to be exported in MS Access and MS Excel formats.

- Interface with mapped and safety data. The system has been designed to directly interface with the mapping software MapInfo; this allows DOLI data to be viewed geographically and analysed against a map of Canada and railway lines. Utilities also allow the import and viewing of safety data, e.g., accidents and incidents, from external sources such as the Transportation Safety Board of Canada.

- Modules for inventory: CN & CP. In addition to the main *DOLI* system there are three additional modules: (a) a detailed inventory module that allows OL to monitor the annual quantities and associated costs of its inventory of materials; it is also used for taking requests, ordering more materials, and shipping; (b) and (c) are view-and-query-only versions of the main *DOLI* system specially developed for CN and CP; they allow CP and CN to view their own data; updated *DOLI* data is exported by OL to CN and CP at regular intervals.

- Data maintenance utilities, e.g., for updating drop-down lists and creating mailing lists).

4. SYSTEM DEMONSTRATION (conducted at the workshop)

5. CONCLUSION

Possible future initiatives include installation of the database on a common server, which would allow all parties to enter the data concurrently onto a single database location. It would also allow for Internet-based entry into the database. The database system is currently based on English, but could be made bilingual in the future. Other future possibilities include direct interface with other safety database systems.

To summarize, the *Database of Operation Lifesaver Information* will enable OL and railway management and staff to answer a variety of questions more efficiently. The comprehensive and standardized base of quality data will permit a better understanding of the educational aspect of the crossing/trespasser problem. In turn, this will enable OL not only to respond to outside queries with confidence, but also to analyse the data such that its safety efforts can be most effective.

The system was designed by RTRAN7 of Ottawa, Canada. The success of the project is due in no small part to the collaboration, commitment, and input of all OL, CN, and CP personnel involved.

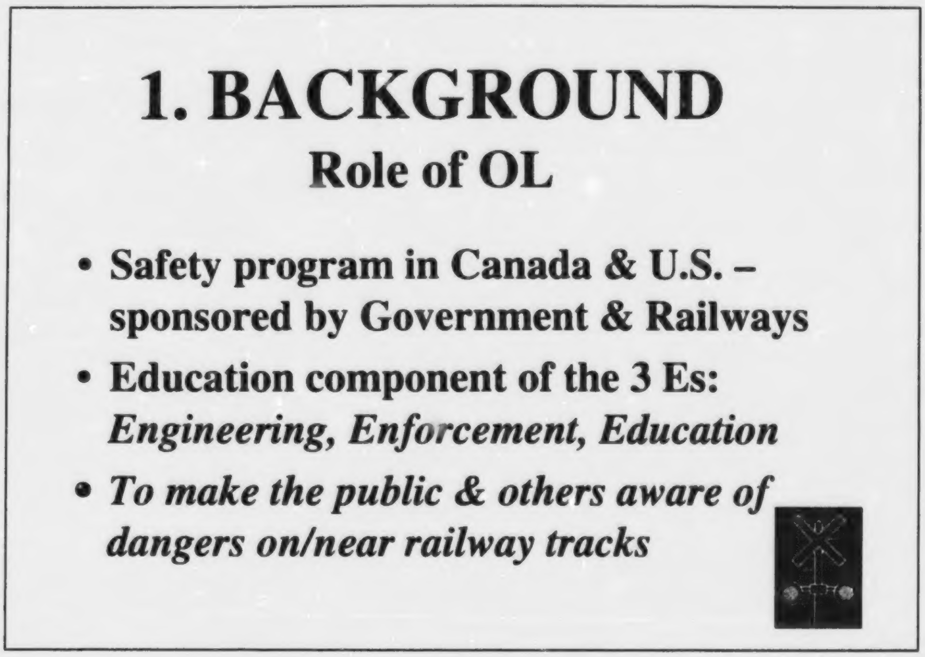
Database
of
Operation Lifesaver Information

DOLI

Presentation by Ranjan Kelly

DOLI PRESENTATION

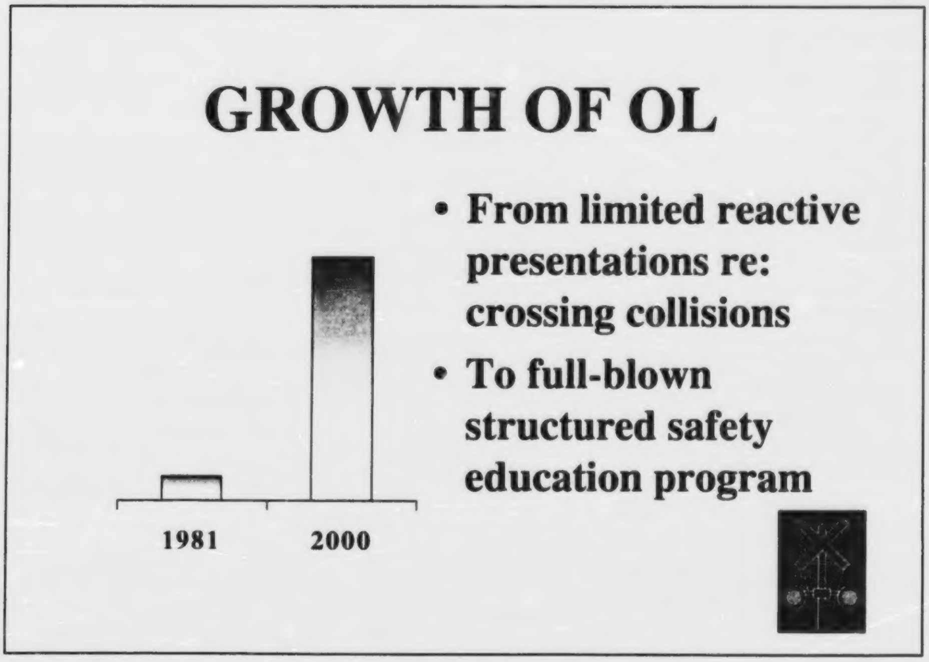
- Background
- Expected Benefits
- Database Features
- Demonstration
- Conclusion



1. BACKGROUND

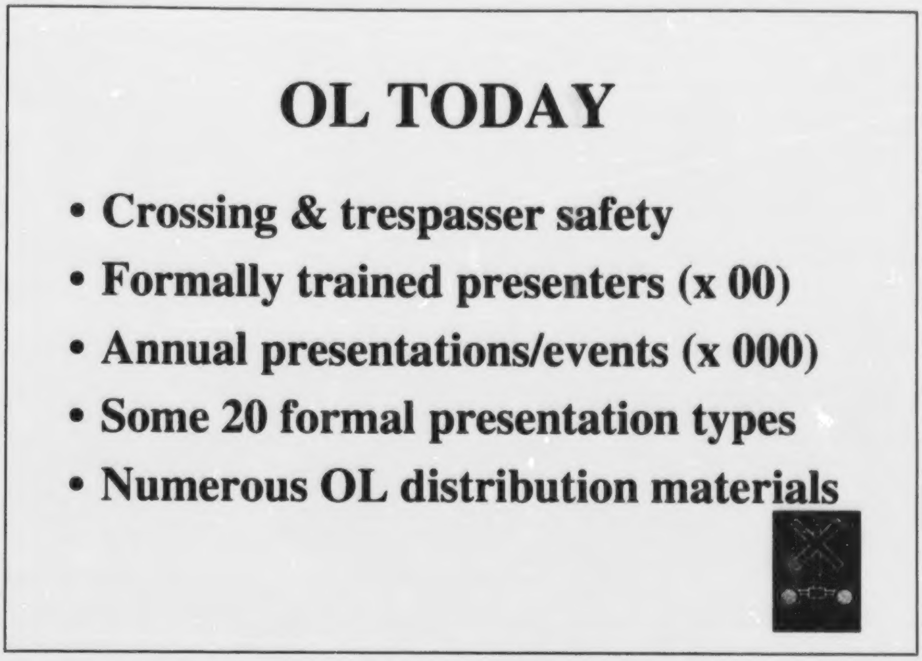
Role of OL

- **Safety program in Canada & U.S. – sponsored by Government & Railways**
- **Education component of the 3 Es: *Engineering, Enforcement, Education***
- ***To make the public & others aware of dangers on/near railway tracks***



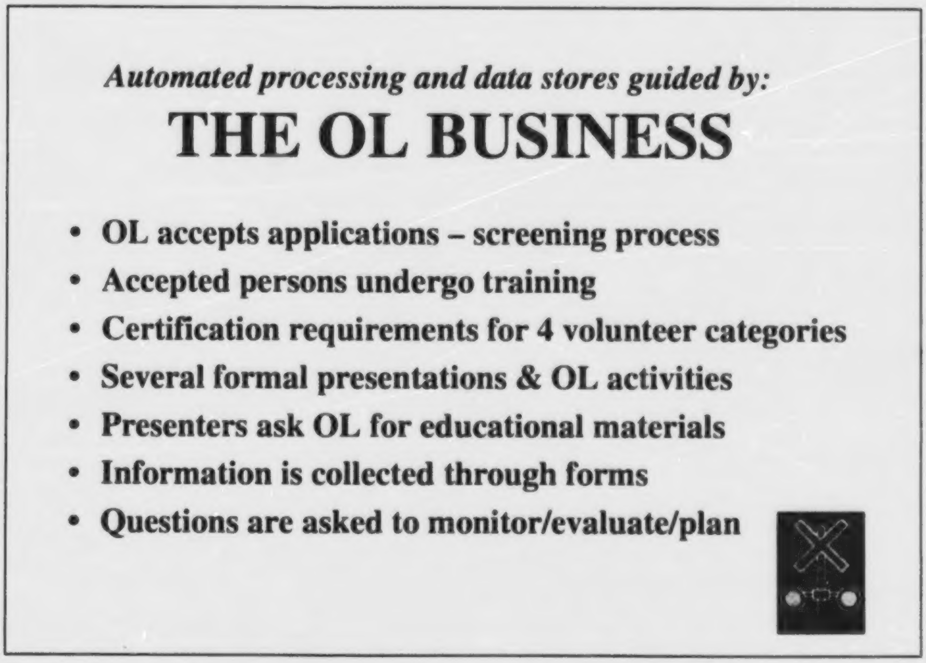
GROWTH OF OL

- **From limited reactive presentations re: crossing collisions**
- **To full-blown structured safety education program**



OL TODAY

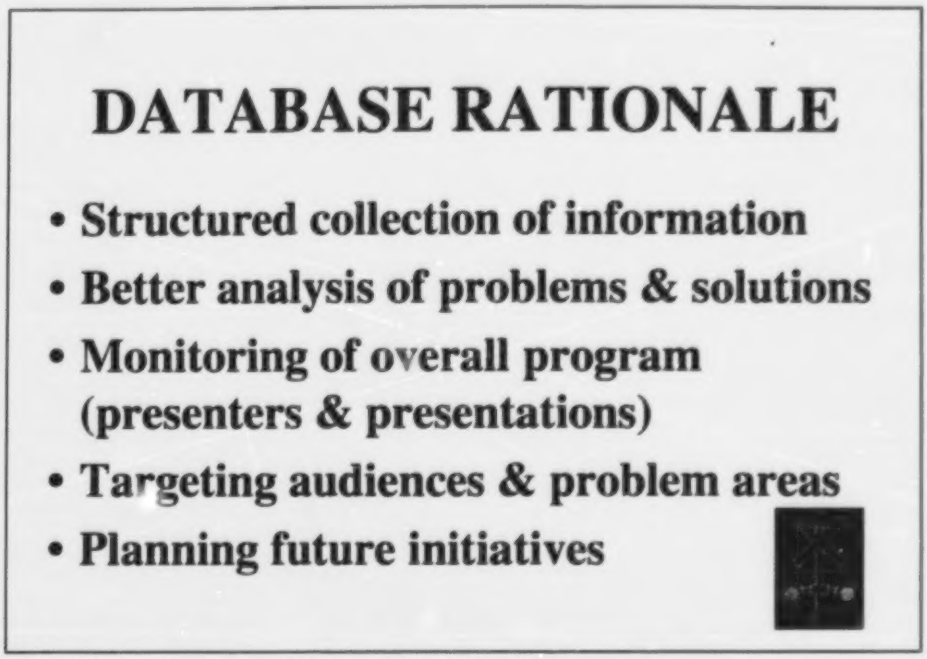
- Crossing & trespasser safety
- Formally trained presenters (x 00)
- Annual presentations/events (x 000)
- Some 20 formal presentation types
- Numerous OL distribution materials



Automated processing and data stores guided by:

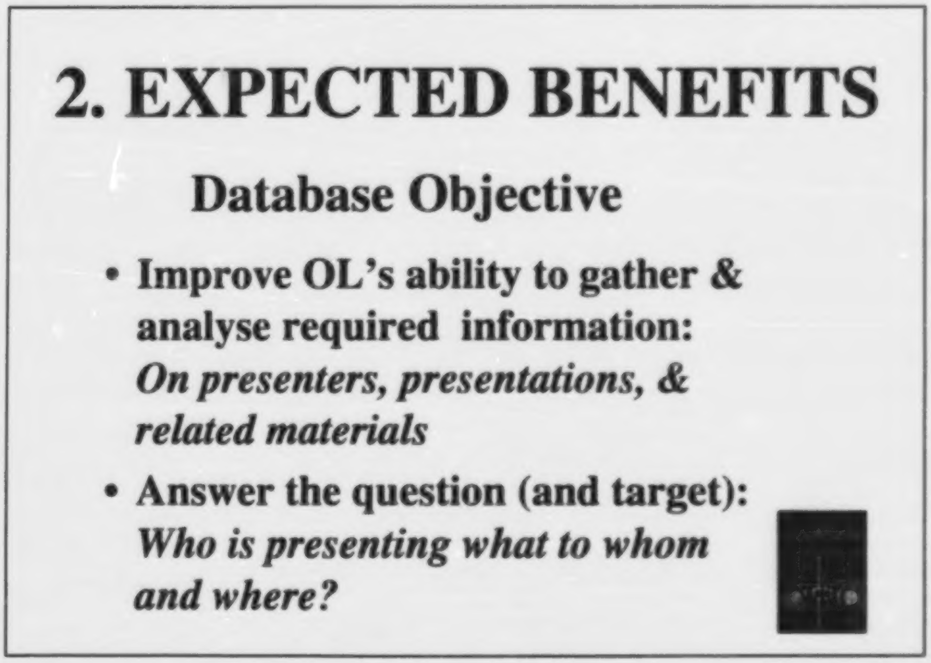
THE OL BUSINESS

- OL accepts applications – screening process
- Accepted persons undergo training
- Certification requirements for 4 volunteer categories
- Several formal presentations & OL activities
- Presenters ask OL for educational materials
- Information is collected through forms
- Questions are asked to monitor/evaluate/plan



DATABASE RATIONALE

- Structured collection of information
- Better analysis of problems & solutions
- Monitoring of overall program (presenters & presentations)
- Targeting audiences & problem areas
- Planning future initiatives



2. EXPECTED BENEFITS

Database Objective

- Improve OL's ability to gather & analyse required information: *On presenters, presentations, & related materials*
- Answer the question (and target): *Who is presenting what to whom and where?*

ENHANCE THE OL PROGRAM

- **Efficient capture of better quality data**
- **Fast & confident response to queries**
- **Convincing capability to monitor, evaluate, focus, & improve safety efforts**
- **Exchange and comparison of data**
- **Ease in future expansion and interface with other systems**
- **OL specific needs (e.g., inventory)**

3. DATABASE FEATURES

- **Relational database platform (MS Access)**
- **Automated data entry for presenter & presentation data – minimum typing**
- **Menus for varied number of query reports – choice of many parameters**
- **On-line and printed help, manuals and documentation**
- **External text-based data provision**

FEATURES (Cont'd)

- Monitoring of presenter process – application, training, and certification
- Consolidated OL and railway data
- Import and export of data capability
- Interface with mapped and safety data
- Modules for inventory; CN & CP
- Data maintenance utilities (e.g., mailings)

4. SYSTEM DEMONSTRATION

- Database of Operation Lifesaver Information
- DOLI

5. CONCLUSION

(Future Possibilities)

- Database server
- Bilingual system
- Direct interface with other databases & systems
- Internet entry – directly into database

- Appreciation to OL & CN/CPR for support, collaboration, & input
- Addition of database will have productive impact on OL

QUESTIONS ?

FRA Safety Web Page

Ron Ries
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Washington, D.C.

SUMMARY

The Federal Railroad Administration (FRA) maintains a Web page from which it is possible to obtain a wealth of data on rail-highway grade crossing collisions and trespasser casualities. The information is taken from incident reports that the railroads are required to file with the FRA. A large number of pre-defined reports are available for viewing and downloading. The information is shown in tables, but the user is also able to see some data in chart format. Incidents and casualties are also shown on state maps indicating which counties have the greatest number of incidents. Users are provided with a large number of reports and can customize the reports by changing a number of variables.

Additionally, users are able to obtain the collision incident reports (FRA from 6180-57) that railroads are required to file with the FRA whenever a grade crossing collision occurs. The grade crossing inventory information that is voluntarily provided by state departments of transportation and by railroads is available for any crossing. It is also possible to download the databases in "dbf" format so that customized reports and inquiries can be constructed using database software.

The site can be accessed through the FRA's Web home page (www.fra.dot.gov) or directly using the following url: http://safetydata.fra.dot.gov.

At the workshop, Mr. Ries demonstrated the use of the FRA Safety Web page.

SOMMAIRE

La Federal Railroad Administration (FRA) possède un site Web qui met à la disposition de l'internaute une foule de données sur les collisions aux passages à niveau et les incidents reliés à des intrusions sur la voie ferrée. Cette information est tirée des rapports d'incidents que les compagnies de chemins de fer sont tenues de soumettre à la FRA. Il est possible de consulter ou de télécharger un grand nombre de rapports, tous en format PDF. L'information est organisée en tableaux, mais certaines données sont aussi présentées sous forme de graphiques. Les données sur les incidents et les victimes sont également données par État, sur des cartes qui indiquent les comtés où surviennent le plus grand nombre d'incidents. Les utilisateurs ont accès à un grand nombre de rapports et ils peuvent personnaliser ceux-ci en modifiant certaines variables.

Il est également possible d'obtenir les rapports d'incidents soumis à la FRA par les compagnies de chemins de fer (formulaire 6180-57 de la FRA) à la suite d'une collision à un passage à niveau. L'information du répertoire des passages à niveau, communiquée volontairement par les départements des transports des États et par les compagnies de chemins de fer, est disponible pour n'importe quel passage à niveau. Il est en outre possible de télécharger les bases de données en format DBF, de façon à pouvoir élaborer des rapports et des requêtes personnalisés à l'aide du logiciel de la base de données.

Le site est accessible via la page d'accueil de la FRA (www.fra.dot.gov) ou directement à l'adresse suivante : http://safetydata.fra.dot.gov.

Lors de l'atelier, M. Ries a expliqué la façon d'utiliser le site Web de la FRA associé à la sûreté.

Grade Crossing Regulations

Daniel Lafontaine
Transport Canada/Transports Canada
Rail Safety/Sécurité ferroviaire
Ottawa, Ontario

SUMMARY

Transport Canada is in the process of preparing Grade Crossing Regulations and Standards. A grade crossing is an intersection between a rail line and a highway and the design is based on highway intersection designs shown in the Transportation Association of Canada *Geometric Design Guide for Canadian Roads*. However, the margin of safety at a grade crossing is less than at road intersections. In the case of a highway intersection, vehicles on a highway can react to other vehicles on an intersection but, at a grade crossing, only the highway vehicle has an opportunity to react. A train travelling on a rail line cannot deviate from its path or, especially in the case of heavy freight trains, stop in time to avoid a collision.

The following research can help in the design of safe grade crossings:

- research of operating characteristics of heavy vehicles (trucks and buses) to provide an adequate warning and clearing time, based on the vehicle's safe stopping distance and acceleration time from a stop
- research on crossing elements to ensure their adequacy
- research on Light Emitting Diodes to obtain a Canadian standard for a grade crossing warning system that may improve safety

SOMMAIRE

Transports Canada est présentement à élaborer un manuel sur les passages à niveau. Un passage à niveau est un franchissement à niveau d'une voie ferrée par une route et sa conception utilise les mêmes principes que la conception des intersections routières énoncés dans les *Normes canadiennes de conception géométrique des routes*, publiées par l'Association des transports du Canada (ATC). Toutefois, la marge de sécurité à un passage à niveau n'est pas aussi grande qu'à une intersection. En effet, tous les véhicules routiers qui se rencontrent à une intersection sont en mesure de réagir les uns aux autres, mais à un passage à niveau, seul l'automobiliste a la possibilité de réagir. Un train qui roule sur une voie ferrée ne peut modifier sa trajectoire pas plus qu'il ne peut, surtout s'il s'agit d'un long train de marchandises, s'immobiliser à temps pour éviter une collision.

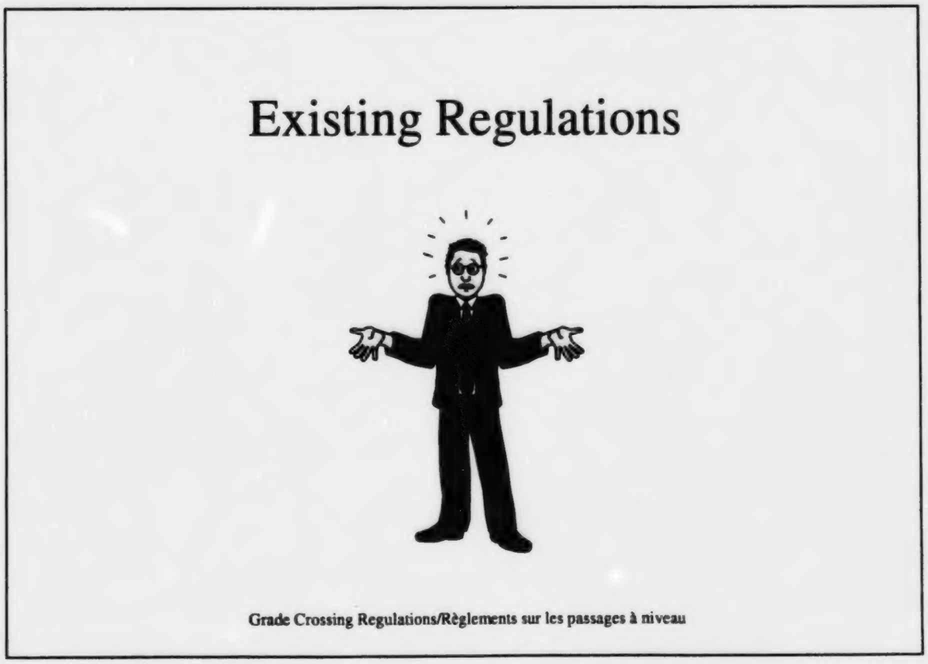
Voici des sujets de recherche susceptibles de contribuer à la conception de passages à niveau sûrs :

- recherche sur les caractéristiques de fonctionnement des véhicules lourds (camions et autocars), de façon que les délais d'avertissement et le temps accordé pour dégager la voie soient suffisants, compte tenu de leurs distances d'arrêt et de leurs performances départ arrêté
- recherche sur les éléments qui composent les passages à niveau, afin de garantir qu'il sont adéquats
- recherche sur les diodes électroluminescentes, en vue de l'élaboration d'une norme canadienne sur un système d'avertissement pour passages à niveau susceptible d'accroître la sécurité

Grade Crossing Regulations
Règlements sur les passages à niveau

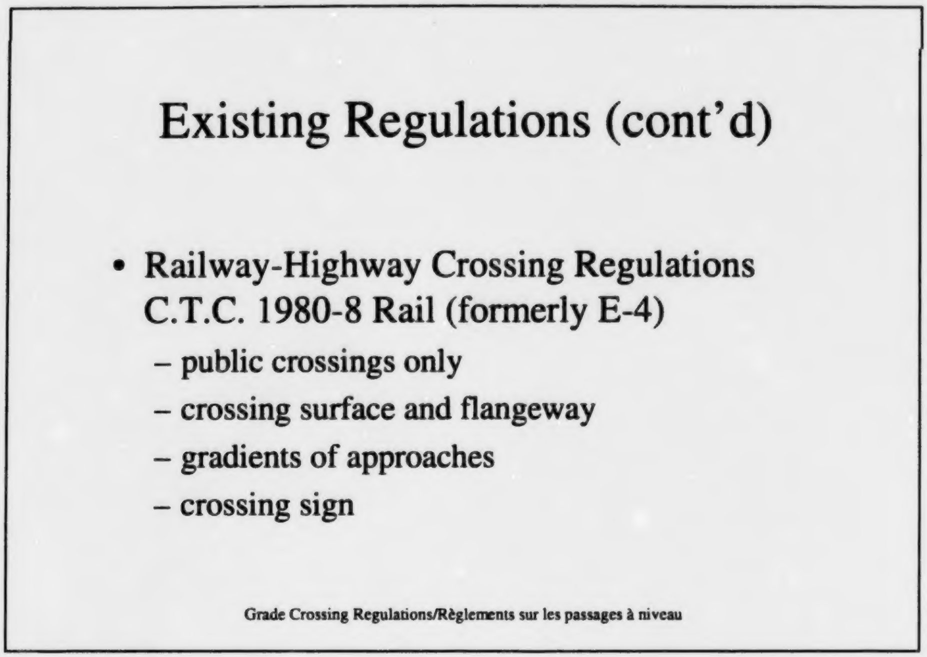
Grade Crossing Workshop
Atelier sur les passages à niveau

Grade Crossing Regulations/Règlements sur les passages à niveau



Existing Regulations

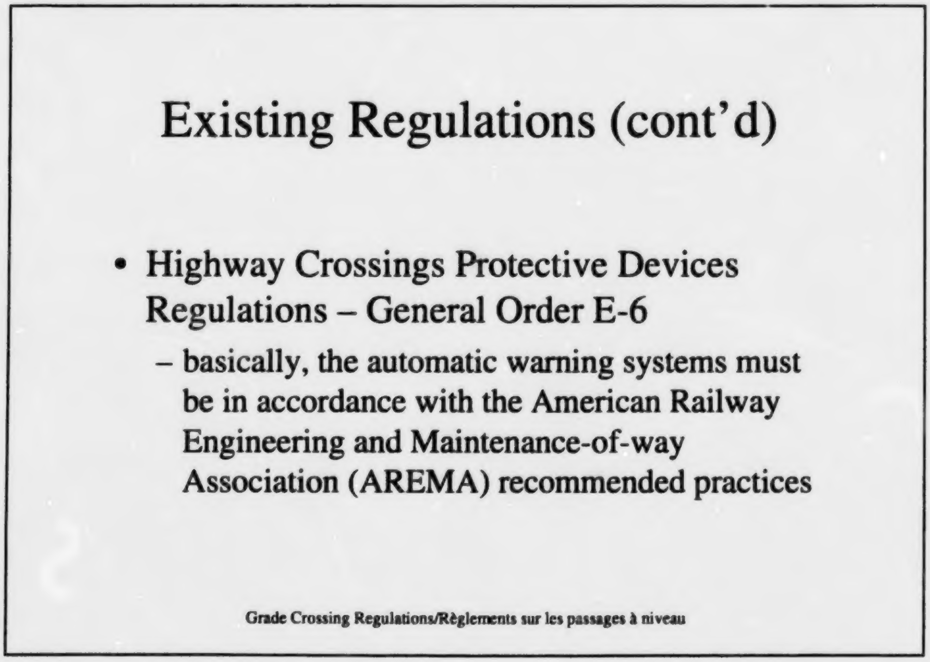
Grade Crossing Regulations/Règlements sur les passages à niveau



Existing Regulations (cont'd)

- Railway-Highway Crossing Regulations C.T.C. 1980-8 Rail (formerly E-4)
  - public crossings only
  - crossing surface and flangeway
  - gradients of approaches
  - crossing sign

Grade Crossing Regulations/Règlements sur les passages à niveau



Existing Regulations (cont'd)

- Highway Crossings Protective Devices Regulations – General Order E-6
  - basically, the automatic warning systems must be in accordance with the American Railway Engineering and Maintenance-of-way Association (AREMA) recommended practices

Grade Crossing Regulations/Règlements sur les passages à niveau

Draft Road-Railway Grade Crossing Manual (1995)

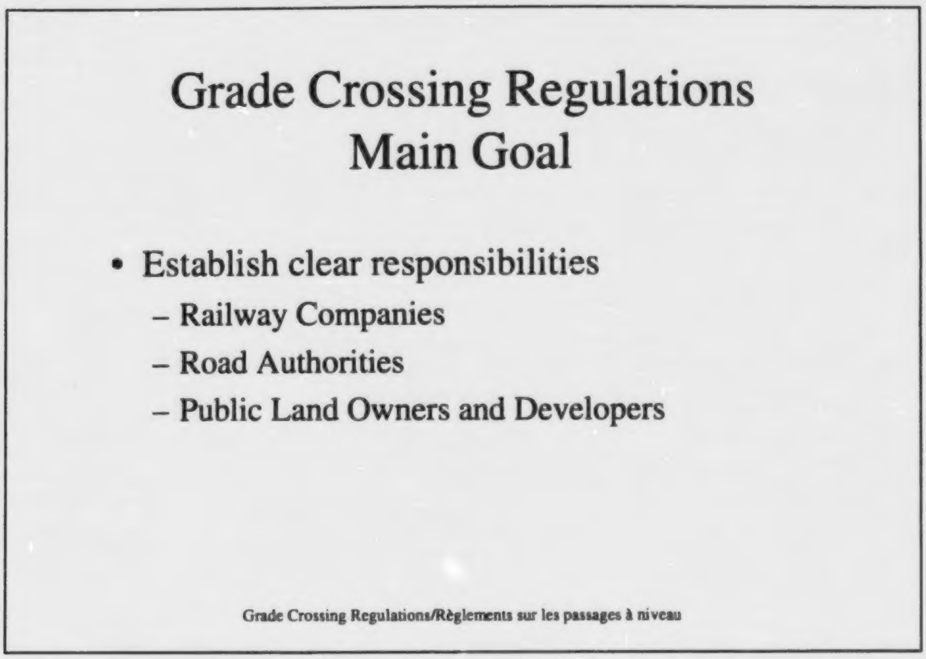
- Manual developed over several years through extensive consultations
- Construction standards, inspection & testing, and maintenance practices
- Manual used as a guideline by highway and railway authorities

Grade Crossing Regulations/Règlements sur les passages à niveau

Proposed Grade Crossing Regulations

- The Rail Safety Consultative Committee (RSCC), formed in the spring of 1999 to review Rail Safety priorities, assigned the development of grade crossing regulations one of the top priorities

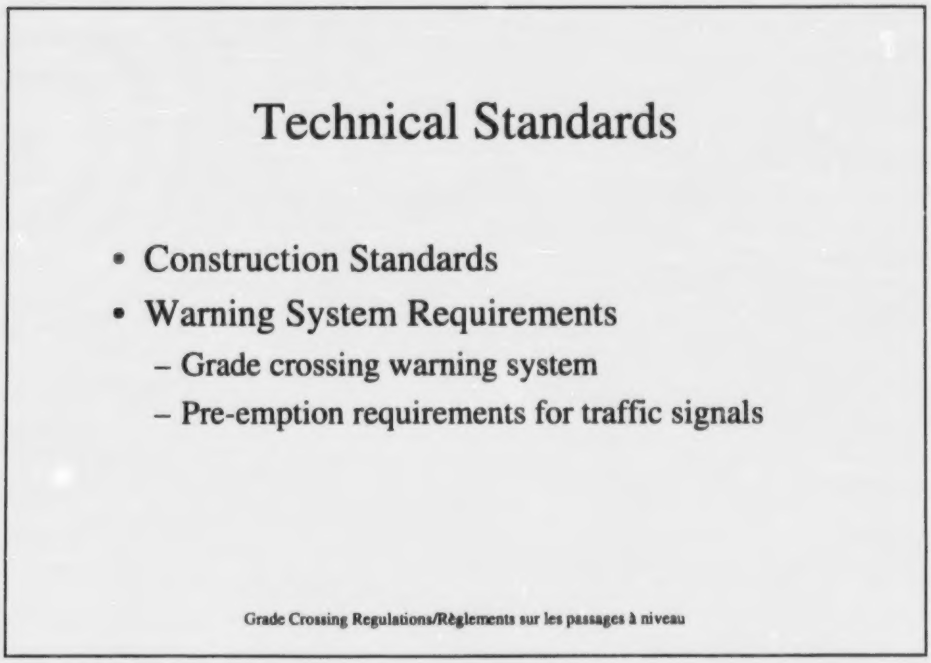
Grade Crossing Regulations/Règlements sur les passages à niveau



Grade Crossing Regulations
Main Goal

- Establish clear responsibilities
  - – Railway Companies
  - – Road Authorities
  - – Public Land Owners and Developers

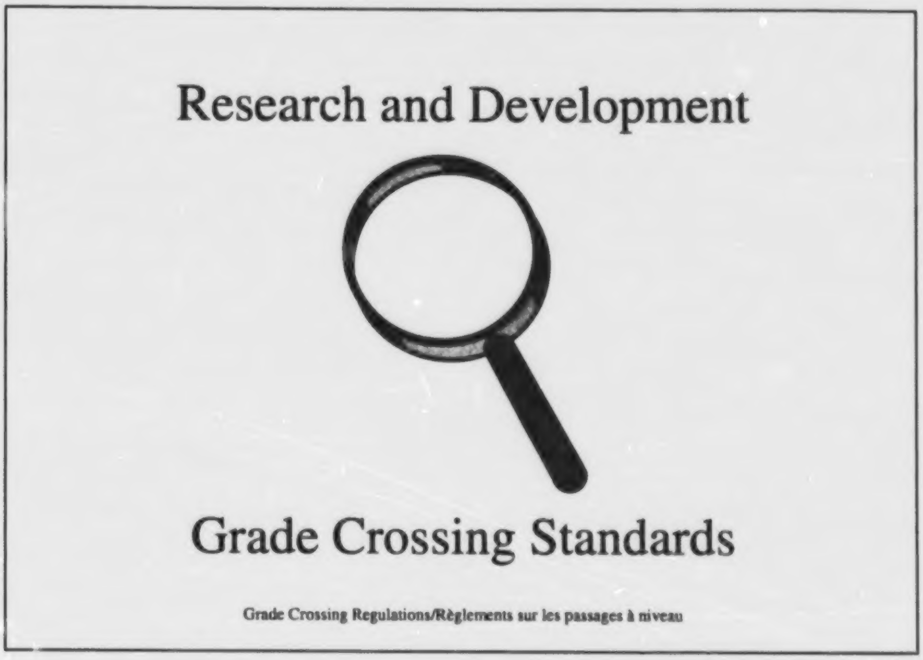
Grade Crossing Regulations/Règlements sur les passages à niveau



Technical Standards

- Construction Standards
- Warning System Requirements
  - – Grade crossing warning system
  - – Pre-emption requirements for traffic signals

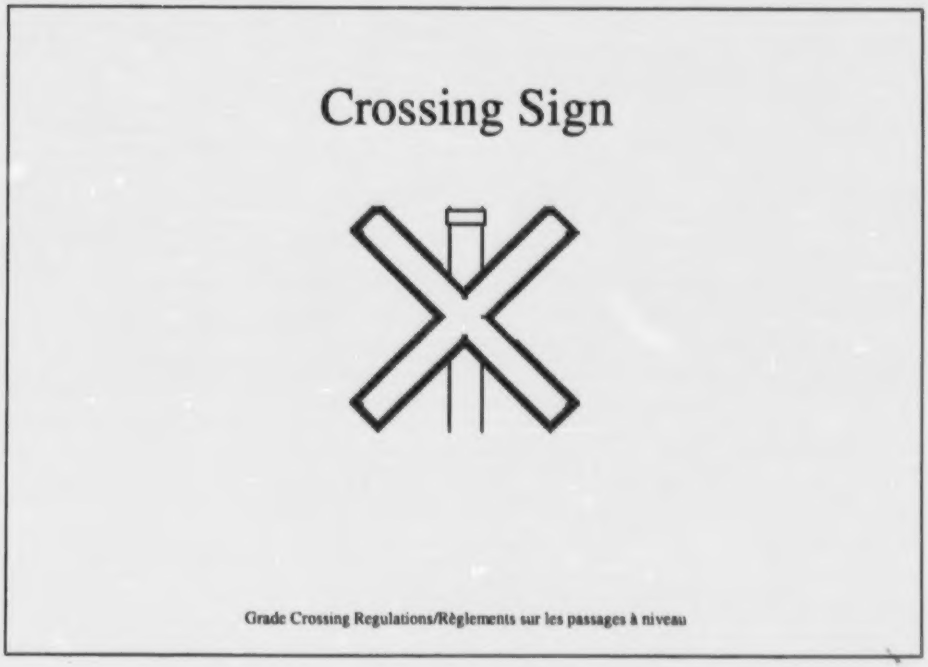
Grade Crossing Regulations/Règlements sur les passages à niveau



Research and Development

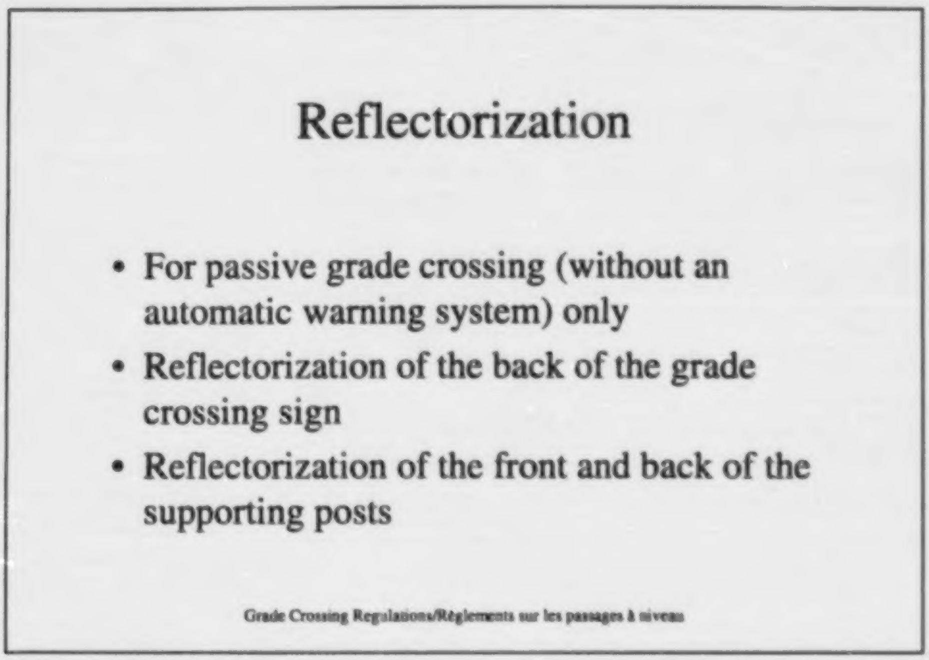
Grade Crossing Standards

Grade Crossing Regulations/Règlements sur les passages à niveau



Crossing Sign

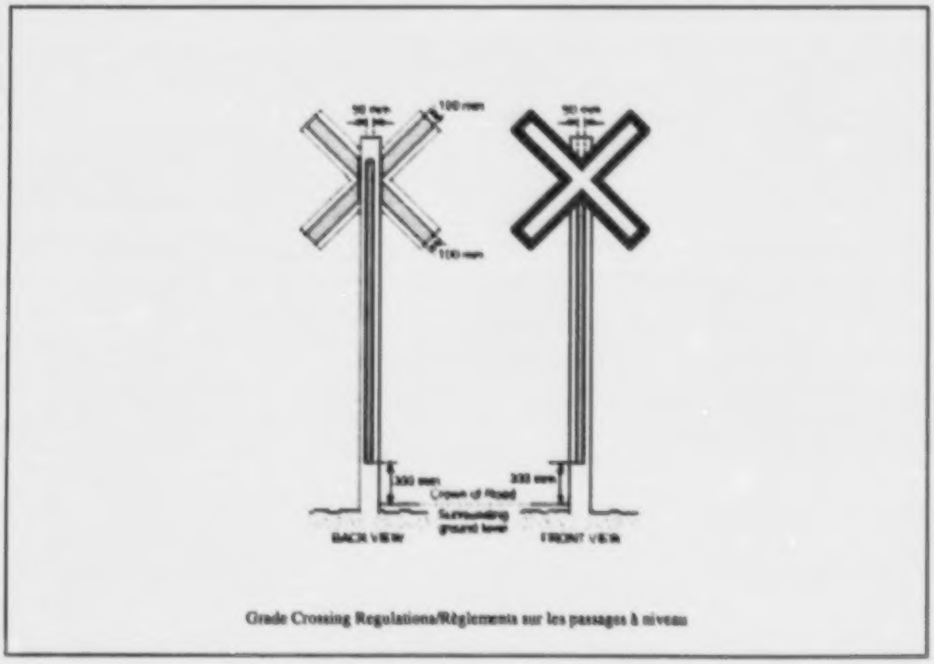
Grade Crossing Regulations/Règlements sur les passages à niveau



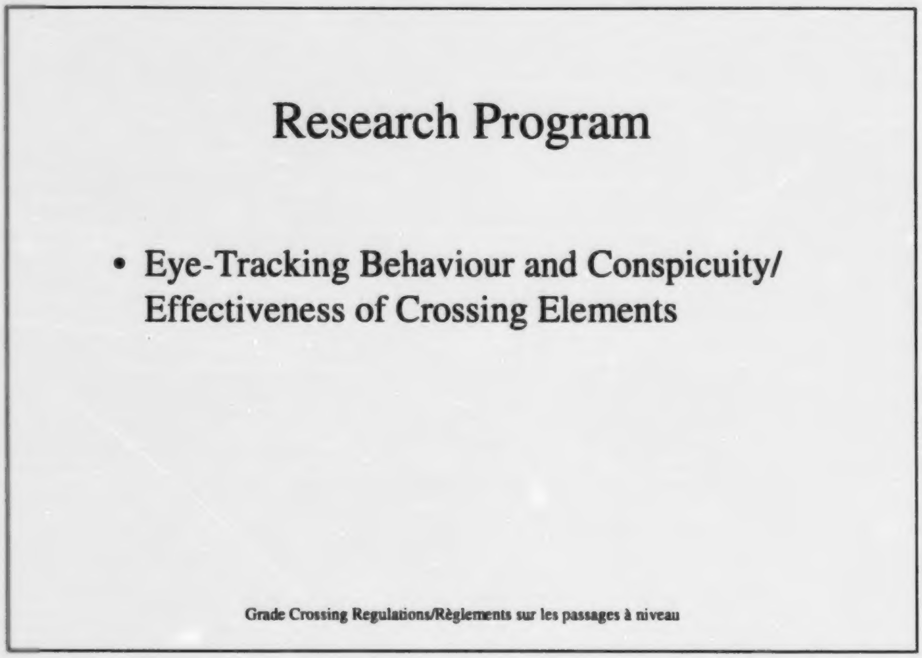
Reflectorization

- For passive grade crossing (without an automatic warning system) only
- Reflectorization of the back of the grade crossing sign
- Reflectorization of the front and back of the supporting posts

Grade Crossing Regulations/Règlements sur les passages à niveau

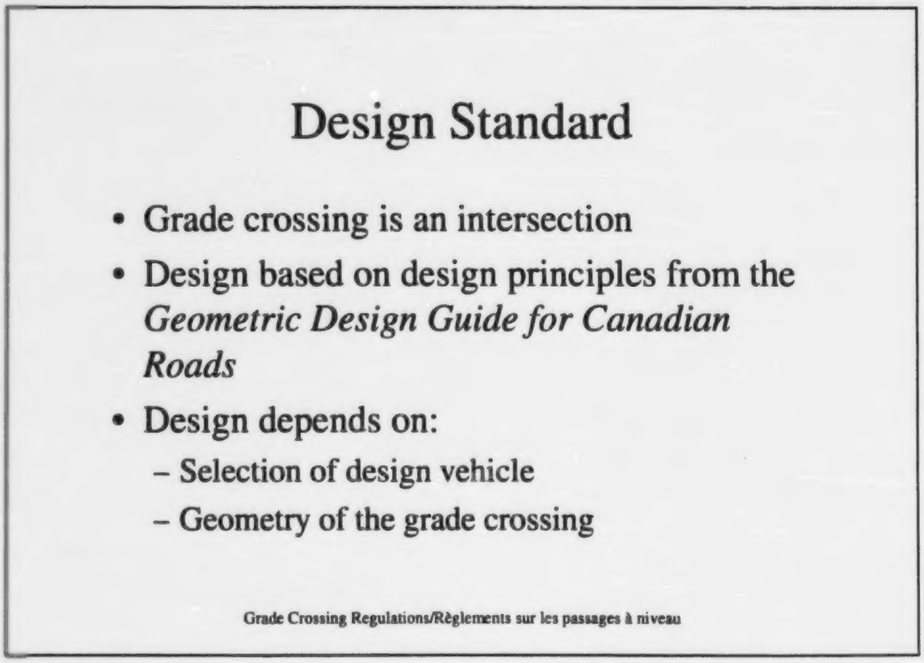

50 mm
100 mm
100 mm
50 mm
300 mm
300 mm
Crown of Road
Surrounding ground level
BACK VIEW
FRONT VIEW

Grade Crossing Regulations/Règlements sur les passages à niveau



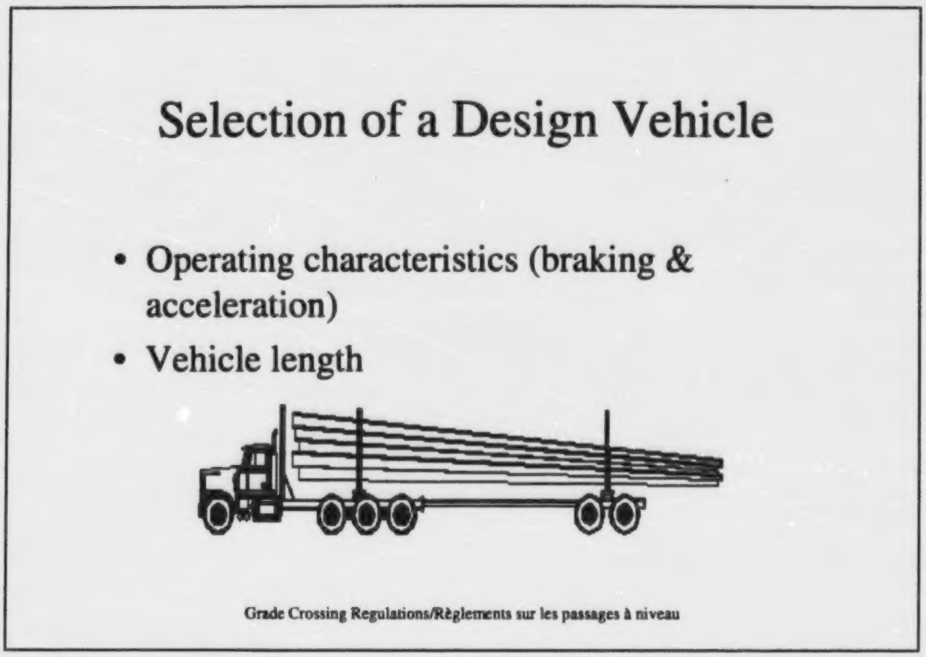
Research Program

- Eye-Tracking Behaviour and Conspicuity/ Effectiveness of Crossing Elements



Design Standard

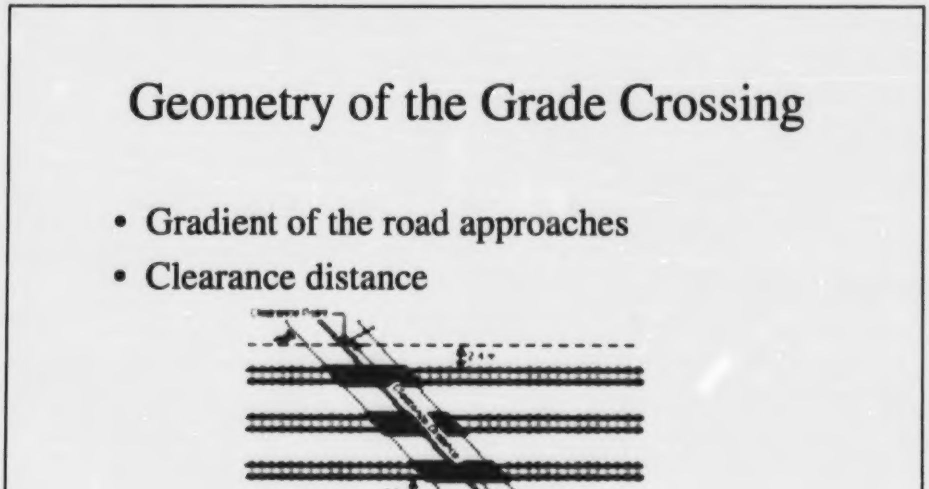
- Grade crossing is an intersection
- Design based on design principles from the *Geometric Design Guide for Canadian Roads*
- Design depends on:
  - Selection of design vehicle
  - Geometry of the grade crossing



Selection of a Design Vehicle

- Operating characteristics (braking & acceleration)
- Vehicle length

Grade Crossing Regulations/Règlements sur les passages à niveau



Geometry of the Grade Crossing

- Gradient of the road approaches
- Clearance distance

Clearance Point
2.4 m
3.3 m
Direction of travel

Grade Crossing Regulations/Règlements sur les passages à niveau

Calculation

- Stopping Sight Distance
- Departure Time
  - Time required for the design vehicle to pass completely through clearance distance
- Warning Time and Gate Clearance Time for Gate Arms

For Sightlines

- To provide adequate sightlines
  - Stopping sight distance
  - Departure time

For Operating Control Circuits

Grade Crossing Warning System

- Design approach warning time for automatic warning systems
  - Warning system activation
  - Gate mechanism
  - Pre-emption requirements

Impacts of Heavy Trucks and Tractor-Trailers on Crossing Safety

- Adequacy of existing design requirements in a grade crossing environment
  - Acceleration from a stop through the grade crossing
  - Road gradients at grade crossing, hump crossing

Light Emitting Diode (LED)

- Develop a recommended standard for warning signals using LED as an alternative to an incandescent light source
- Enhance existing warning systems

Daniel Lafontaine

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Trespassing and Suicide: Dealing with Human Tragedy

Terrence Culhane
Metropolitan Transportation Authority (MTA) Police Department
New York, New York

ABSTRACT

This paper briefly describes a program developed by the MTA Police Department to address trespass issues using an approach based on education, engineering, and enforcement. It outlines the program components of each element and provides the results to date.

RÉSUMÉ

Ce document décrit brièvement un programme lancé par le service de police de la MTA pour tenter de résoudre le problème des intrusions sur les propriétés ferroviaires. Le programme comprend trois volets : éducation, ingénierie et application de la loi. Le document expose les éléments de chacun de ces trois volets ainsi que les résultats obtenus à ce jour.

THE MTA POLICE DEPARTMENT was formed in 1998 by merging the Long Island Rail Road (LIRR) and the Metro North Rail Road Police departments. The department has about 481 officers with an authorized strength of 531. It is tasked with providing police services on both the Long Island Rail Road and the Metro North Rail Road as well as at all East River toll crossings (7 bridges and 2 tunnels).

The LIRR's longest run is about 108 miles. The system has 308 active grade crossings. The LIRR has a daily ridership of approximately 200,000. The Metro North Rail Road has a run of 95 miles, almost 100 active crossings, and a daily ridership of approximately 150,000.

Prior to the merger of the two departments, the LIRR Police Department conducted a study of train fatalities for a ten-year period. The results revealed that there were an average of 30 fatalities a year with a suicide rate of approximately 65 percent. The study also revealed that the majority of incidents were not occurring at grade crossings, but rather along our right-of-ways. This indicated a need for enhanced trespass abatement programs.

Using the data collected from the study we embarked on a program to directly address trespass issues based on the philosophy of the 3 Es: education, engineering, enforcement.

EDUCATION

- Operation Lifesaver targets adult and professional drivers and civic groups. Sub-programs target law enforcement agencies that respond to incidents on our properties to stress the importance of trespass incidents.

- T.R.A.C.K.S program incorporates Operation Lifesaver principles and was tailored to target schoolchildren of all ages. Program currently given to about 175,000 children yearly.

- Officer on Train Program was modified to put judges, prosecutors, and adjoining police agencies on trains to enable them to witness what happens in the engineer's cab and the tension that engineers experience. It allows them to experience the near hits and trespass incidents first hand.

ENGINEERING

- High incident areas were identified.
- Funding was secured by determining the cost of fatalities for a one-year period.
- Funding was used to research and develop a vandal-proof fence, now known as the Long Island fence.
- Fence cost is about $130 a linear foot.
- Fence was installed in a one-mile area in Nassau County for a cost of about $700,000.
- To date, incidents have been virtually eliminated.

ENFORCEMENT

- Department adopted a zero tolerance for trespass.
- It pursued legislation and made trespassing in a posted area on a railroad a misdemeanour rather than a violation.

This year train fatalities number 42, of which 21 (50 percent) were classified as suicide, 13 as accidents, and 8 are yet to be categorized. The age of persons involved ranged from 13 to 79. The highest incidence was in the 20-40 group, with about 10 in each age group.

Low-Cost Active Warning System at Low-Volume Crossings – The Answer for the Lonely Crossbuck?

Stephen J. Bahler
Minnesota Department of Transportation
St. Paul, Minnesota

SUMMARY

The Minnesota Department of Transportation (Mn/DOT) is concerned with railroad-highway crossing safety. In particular, crashes at low-volume crossings have been difficult to predict and difficult to prevent with passive signs and pavement markings. These crossings are expensive to upgrade to active warning systems. In 1997-1998, Mn/DOT successfully demonstrated an in-vehicle railroad crossing warning system for school buses. Slightly modified technology was used in a successful demonstration at a low-volume crossing on April 20, 2000. Based on those two successes, Mn/DOT issued a Request for Proposals for Partners to install, test, and evaluate a low-cost active warning system at 100 railroad crossings in central Minnesota. This presentation provides some details on the history leading to this proposed test as well as on the test. It concludes with an invitation to work together to determine a role for Transport Canada in the upcoming operational test.

SOMMAIRE

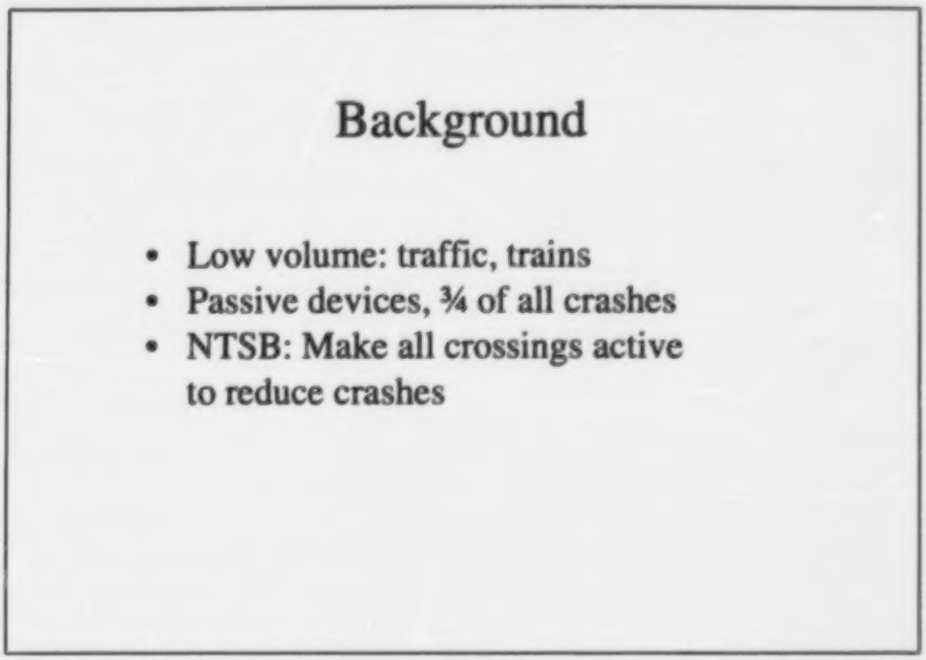
Le Minnesota Department of Transportation (Mn/DOT) est préoccupé par la sécurité aux passages à niveau. Il a noté en particulier que la signalisation non automatisée et les marquages sur la chaussée s'avèrent peu efficaces à prévenir les accidents aux passages peu fréquentés. Or, il est coûteux de doter ces passages à niveau de systèmes d'avertissement automatisés. En 1997-1998, le Mn/DOT a fait une démonstration concluante d'un système embarqué d'avertissement de l'approche d'un passage à niveau pour autobus d'écoliers. Un système légèrement modifié a été utilisé avec succès lors d'une démonstration à un passage à niveau à faible débit de circulation, le 20 avril 2000. Fort de ces deux succès, le Mn/DOT a lancé une Demande de propositions en vue de trouver des partenaires pour installer, mettre à l'essai et évaluer un système d'avertissement automatisé peu coûteux à 100 passages à niveau du centre du Minnesota. Cette présentation fait un bref historique de l'essai projeté et trace les grandes lignes de l'essai comme tel. Il se termine par une invitation à Transports Canada à jouer un rôle dans la réalisation de l'essai en service réel prévu pour bientôt.

Low-Cost Active Warning System at Low-Volume Crossings – The Answer for the Lonely Crossbuck?

Stephen J. Bahler
Minnesota Department of Transportation
St. Paul, Minnesota

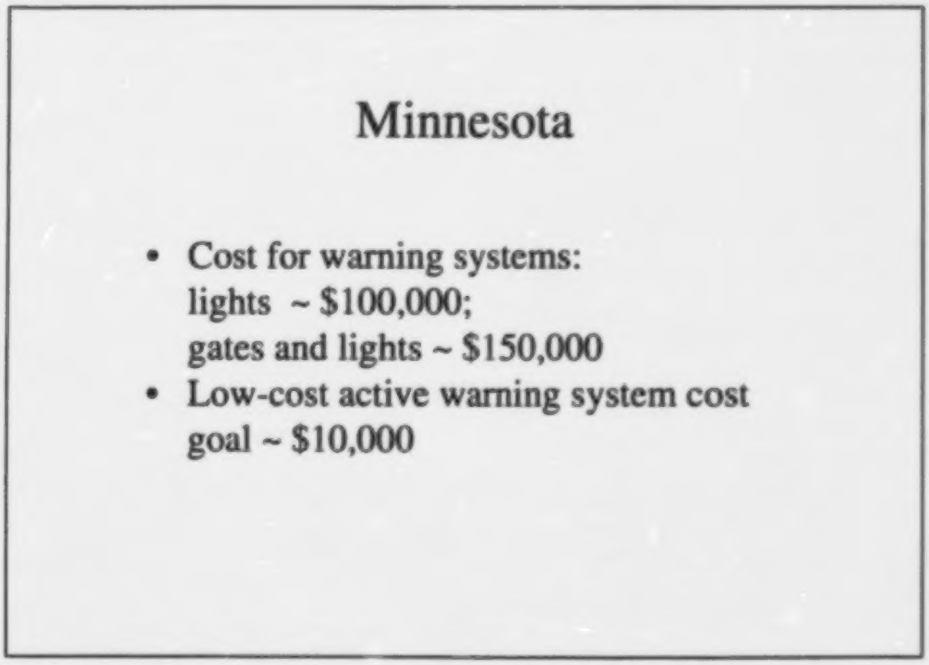
Outline

- Background
- In-vehicle signing
- April 20, 2000 active sign demo
- Operational test
- Opportunity for partnership?
  (Hands across the boundary waters)



Background

- Low volume: traffic, trains
- Passive devices, ¾ of all crashes
- NTSB: Make all crossings active to reduce crashes



Minnesota

- Cost for warning systems:
  lights ~ $100,000;
  gates and lights ~ $150,000
- Low-cost active warning system cost goal ~ $10,000

In-Vehicle Signing

- Completed 1997-1998: 25 school buses; in-vehicle crossing warning; in-vehicle train proximity warning
- Evaluation: drivers generally liked; not enough data to prove reliability

Demo: System Features

- Demonstrated at V-PAS
- Potential low $$: installation; maintenance
- No in-track equipment
- Two-way communication for verification and evaluation

Op Test Goals

- ~ 100 crossings for three years to evaluate
- Safety performance goal: work just like active
- Operational performance goal: same as active
- Reliability goal: 6-sigma
- Maintenance goal: cheap and easy

Op Test Tasks

- Phases
  - AAR test track
  - 1 crossing per 6 counties
  - 10 sequential crossings
  - 100 crossings
  - other: test plan; three-year operations and maintenance
- Collection of evaluation data
- Evaluation

Op Test Schedule

- 4 proposals – Nov. 8, 2000
- Selection: Dec. 2000
- Contracts ~ early 2001
- Full-scale op test ~ fall 2001

Proposers

- C3 Train Systems: $1+ million
- 3M/DVSS: $1.5+ million
- Standard Signal: $2+ million
- EVA: $4+ million

Opportunity for Partnership

- Transport Canada Role?
- Op. Test?
- Functional requirements
- Performance requirements
- Test sites
- Evaluation?
- Other?

Les données recueillies se rapporteront à cinq variables reliées aux deux objectifs visés, soit la sécurité et la qualité de vie :

1. Les infractions des automobilistes
2. Les niveaux sonores à divers endroits sur la route, selon leur proximité du passage à niveau
3. Les niveaux sonores dans les zones habitées, selon leur proximité du passage à niveau
4. Les perceptions des mécaniciens de locomotives quant à la sécurité
5. Les perceptions des résidents du voisinage quant à l'effet des niveaux sonores sur leur qualité de vie

Pour la mesure de la première variable, des caméras de surveillance seront montées à proximité du passage à niveau. Les images enregistrées par les caméras permettront de déterminer s'il y a infraction, mais il ne sera pas possible d'identifier le véhicule ni le conducteur. Pour les deuxième et troisième variables, des appareils portatifs d'enregistrement sonore seront utilisés. Pour les deux dernières mesures on aura recours à des sondages.

Le projet sera lancé au début de 2001, et les rapports finals sont attendus au printemps 2002.

Pour de plus amples renseignements, prière de s'adresser à :
Roy Lucke, Northwestern University Center for Public Safety, (847) 491-5230, rlucke@nwu.edu
Kenneth Marabella, Village of Mundelein, Illinois, (847) 949-3225, kmarabella@mundelein.org

Automated Horn System Study

Kenneth W. Marabella
Village Administrator
Village of Mundelein, Illinois

SUMMARY

Train-vehicle collisions at grade crossings continue to decrease, but the severity of such crashes still commands public attention.

Crashes often occur because drivers ignore crossing warnings. Studies have found that when train horns were sounded, crashes were fewer than when they were not sounded. However, horn use is perceived as diminishing the quality of life of those living or working near crossings.

Local governments are searching for means to reduce or eliminate the train horns while retaining their safety aspects. One option is the wayside train horn. This device, mounted on the gate crossing standards, sounds a horn similar to a train horn when the crossing gates are activated. However, the noise is directed down the crossing roadway rather than down the tracks.

The Village of Mundelein, Illinois, along with other participating units of government and involved agencies, asked the Northwestern University Center for Public Safety to evaluate the effectiveness of a demonstration installation of wayside horns. This study is being conducted with federal and local matching funds under the auspices of the Federal Railroad Administration and the Volpe National Transportation Research Center. Although the horns are to be installed at all nine crossings in or near the Village, only three are proposed for use in the evaluation.

The study will determine whether wayside horns provide the same level of crossing safety as the train horn while improving the quality of life in the surrounding area. This proposed study has a traditional before/after structure. "Before" is the current condition, and "after" occurs at some point after motorists have become accustomed to the wayside horn.

Data will be gathered for five measures to satisfy both objectives, safety and quality of life:

1. Motorist violations of the crossing gates
2. Sound levels at various distances along the roadway approaching the crossing
3. Sound levels in occupied areas at various distances from the railroad crossings
4. Train engineers' perceptions of safety
5. Residents' perceptions of quality of life as related to the sound levels

The first measure will involve the use of cameras mounted near the crossings to monitor crossing violations. Pictures taken by the cameras will be suitable for determining when violations occur, but

will not allow identification of the vehicle or driver. For the second and third measures, portable sound recording devices will be used. The final two measures will involve surveys.

The project will be initiated in early 2001, with final reports completed by the Spring of 2002.

For further information, please contact:
Roy Lucke, Northwestern University Center for Public Safety (847) 491-5230, rlucke@nwu.edu
Ken Marabella, Village of Mundelein, Illinois (847) 949-3225, kmarabella@mundelein.org

SOMMAIRE

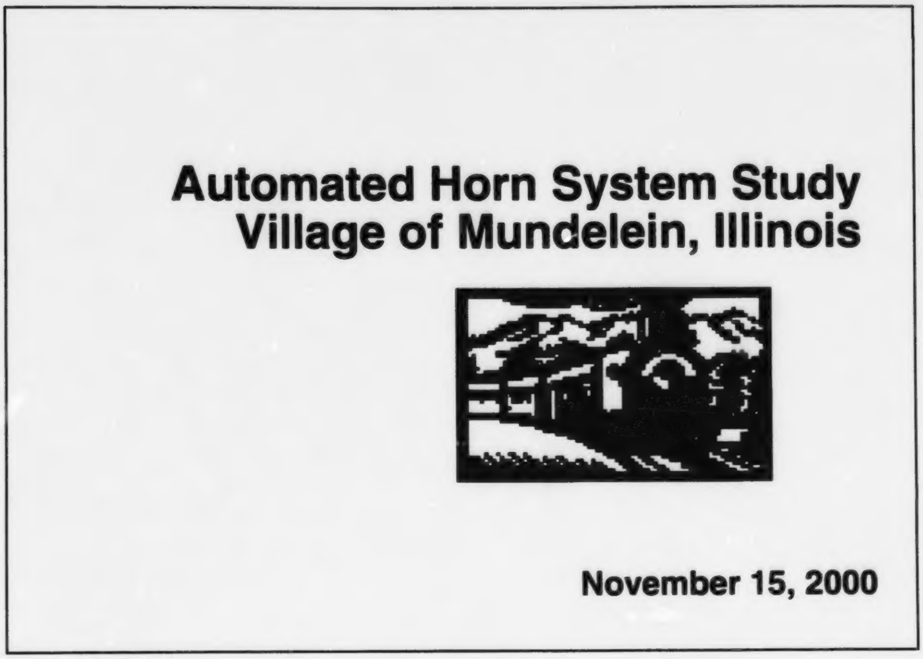
Les collisions train-véhicule aux passages à niveau sont en constante diminution, mais la gravité de ces accidents commande l'attention des organismes publics.

Beaucoup d'accidents sont attribuables au fait que les automobilistes ne respectent pas les signaux d'avertissement. Des études ont révélé que lorsque le klaxon du train est activé, les accidents sont moins nombreux que lorsqu'il n'est pas activé. Mais l'utilisation du klaxon est perçue comme nuisant à la qualité de vie des personnes habitant à proximité des passages à niveau.

Les administrations locales sont à la recherche de moyens qui permettraient de réduire, voire d'éliminer le recours au klaxon, sans mettre la sécurité en péril. Une des options envisagées est le klaxon en bordure de voie. Ce dispositif, monté aux poteaux qui soutiennent les barrières, émet un son semblable à celui du klaxon de train lorsque les barrières sont activées. Mais le bruit est dirigé vers la chaussée et non vers la voie ferrée.

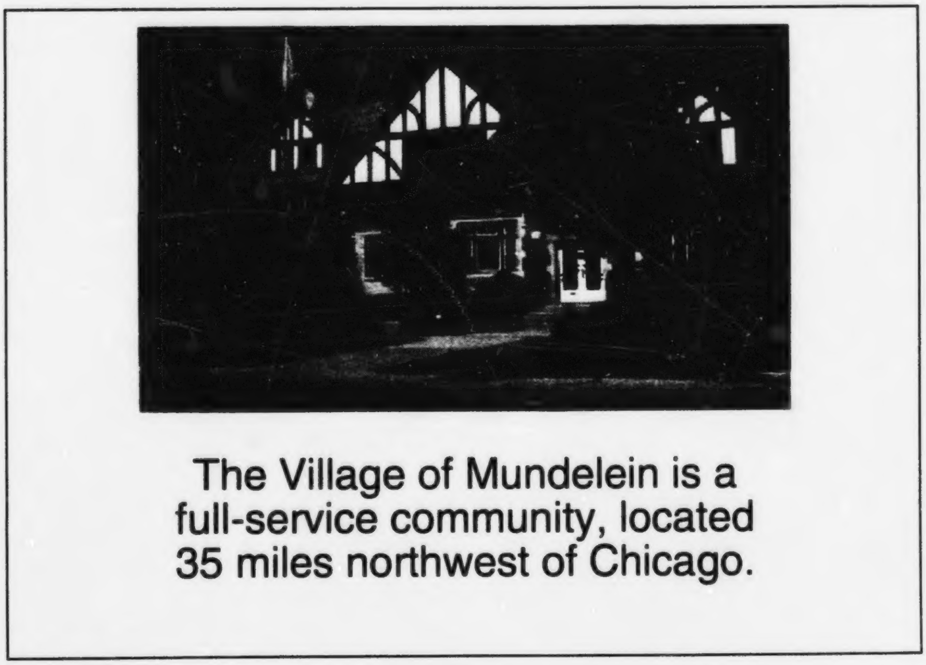
Le Village de Mundelein, en Illinois, de concert avec divers organismes gouvernementaux et autres organisations intéressées, a demandé au Northwestern University Center for Public Safety d'évaluer l'efficacité d'une installation de démonstration de klaxons en bordure de voie. Cette étude, financée à parts égales par les administrations locales et fédérales, est menée sous les auspices de la Federal Railroad Administration et du Volpe National Transportation Research Center. Des klaxons seront installés aux neuf passages situés sur le territoire du Village ou à proximité, mais il est prévu d'en évaluer seulement trois.

L'étude permettra de déterminer si les klaxons en bordure de voie procurent le même degré de sécurité que les klaxons de train, tout en améliorant la qualité de vie des personnes qui vivent dans les environs. Cette étude répond à la démarche classique avant/après. «L'avant» correspond à la situation actuelle, et «d'après» au moment, à déterminer, où les automobilistes seront habitués au klaxon en bordure de voie.

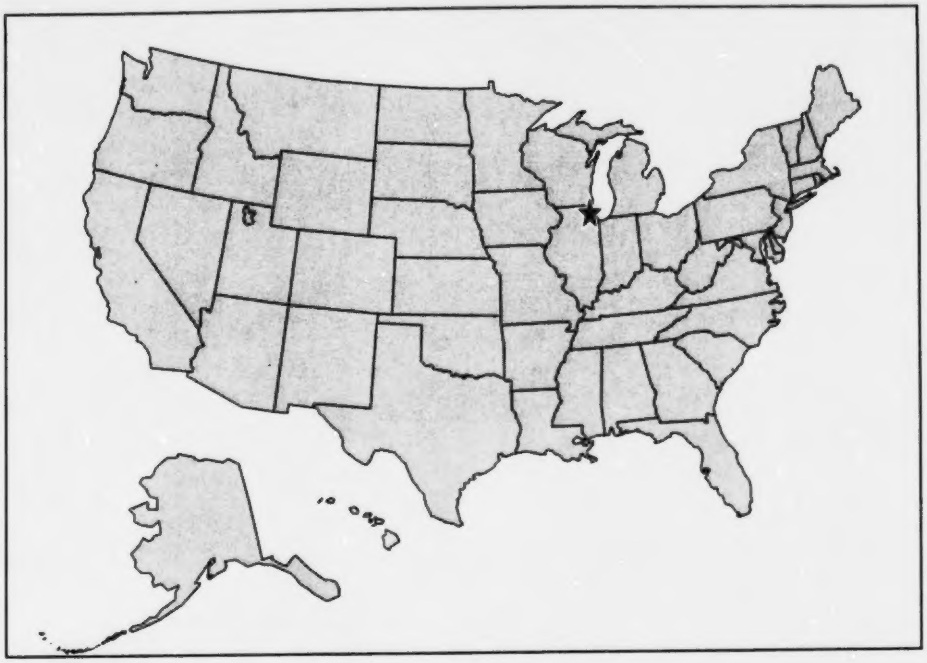


Automated Horn System Study
Village of Mundelein, Illinois

November 15, 2000



The Village of Mundelein is a full-service community, located 35 miles northwest of Chicago.

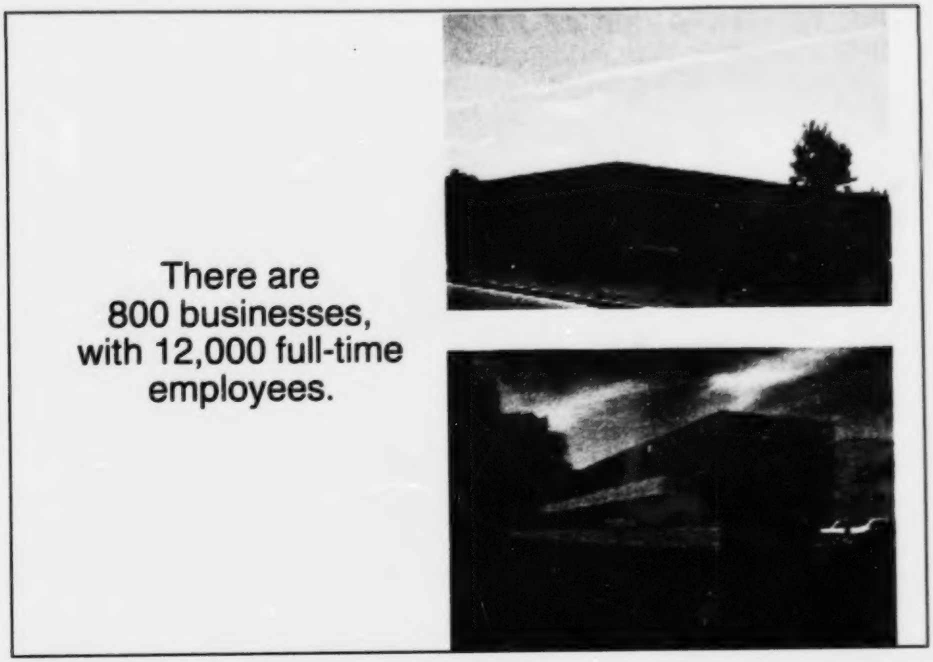


Population: 29,000

Dwelling units: 10,000

Price: $130,000 – $400,000

Median Income: $45,947

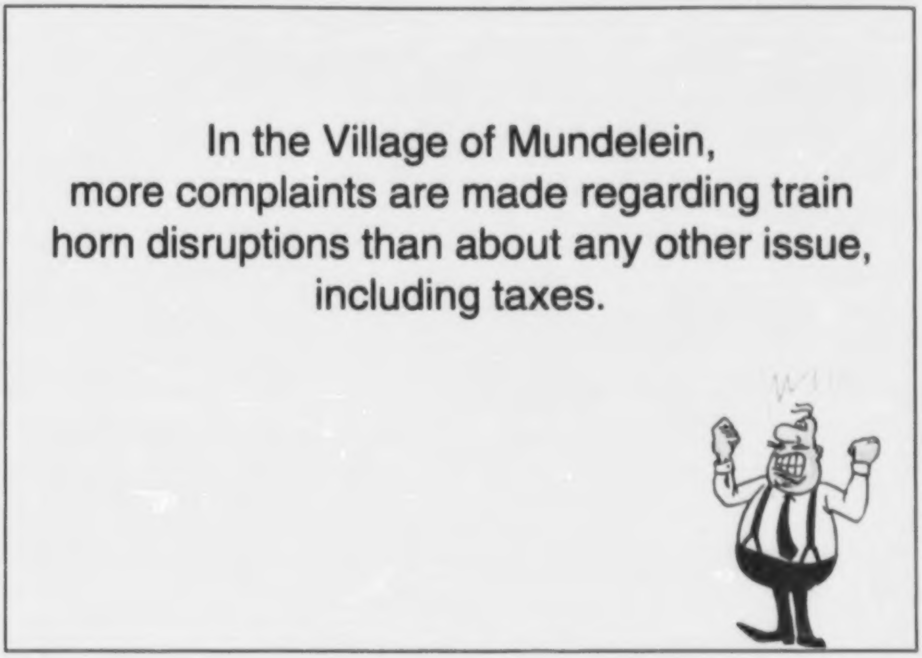


There are
800 businesses,
with 12,000 full-time
employees.

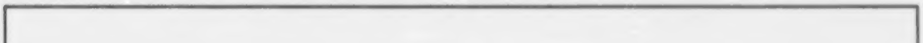
With 42-50 train movements per day, the Village of Mundelein has long been concerned about rail safety and quality of life issues related to train horns.

Project Area

- Located on Wisconsin Central Freight Line
  - Shared with Metra Commuter Service
- Nine Highway Crossings
  - Two State
  - Three County
  - Four Local



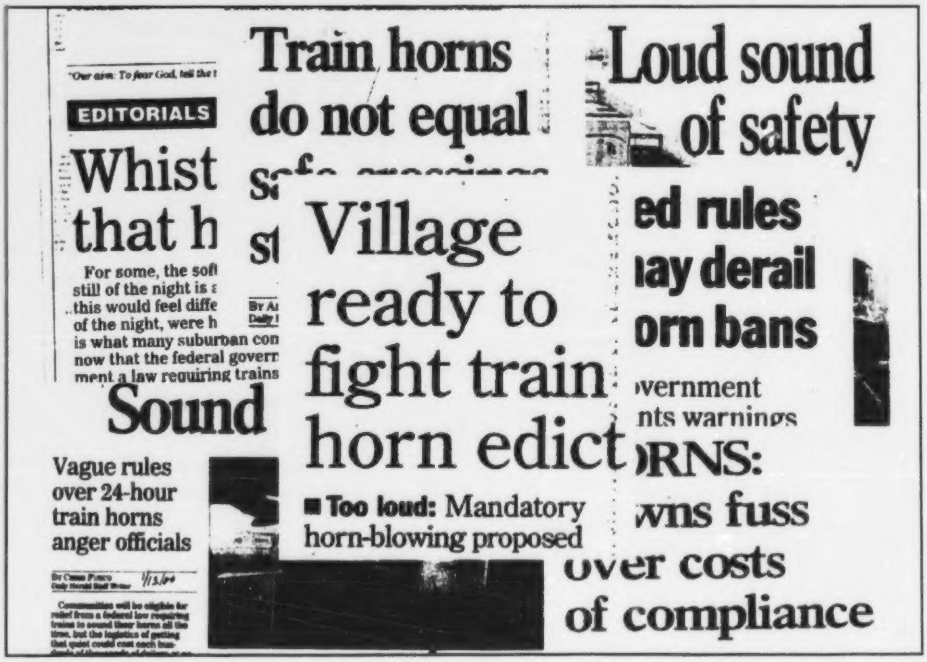
In the Village of Mundelein, more complaints are made regarding train horn disruptions than about any other issue, including taxes.



Depending on weather conditions, the train horns can be disruptive for up to two miles.

The Swift Rail Act's requirement that train horns be sounded at every crossing has made whistle blowing a national issue.

Across the country, required whistle blowing has been met by strong resistance.



"Our aim: To fear God, tell the

EDITORIALS

Whist
that h

For some, the soft
still of the night is
this would feel diffe
of the night, were h
is what many suburban con
now that the federal goverr
ment a law requiring trains

Sound

Vague rules over 24-hour train horns anger officials

Train horns do not equal

By A
Daily

Village ready to fight train horn edict

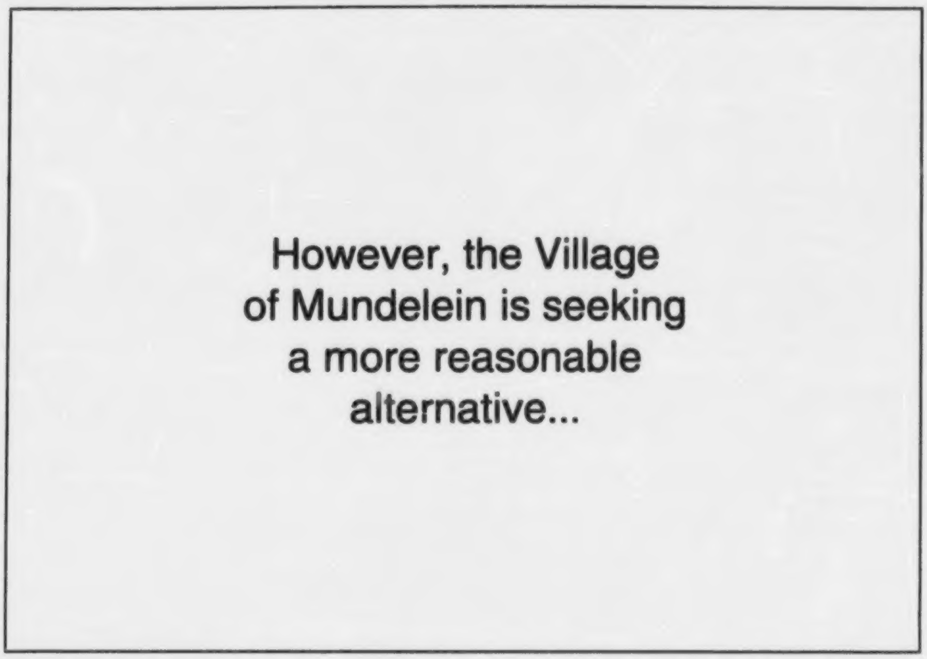
■ Too loud: Mandatory horn-blowing proposed

Loud sound of safety

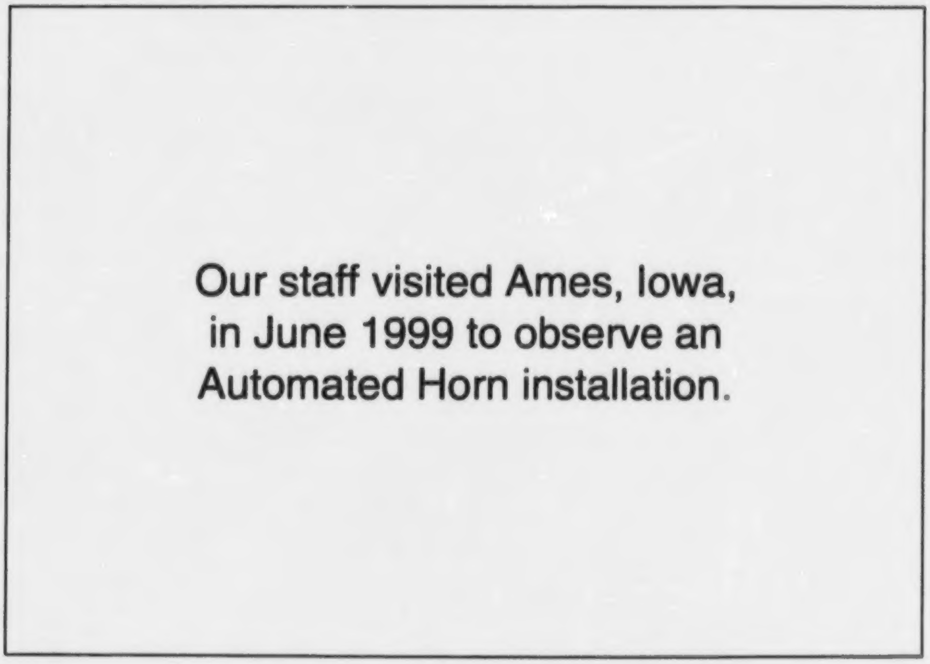
ed rules
nay derail
orn bans

vernment
nts warnings

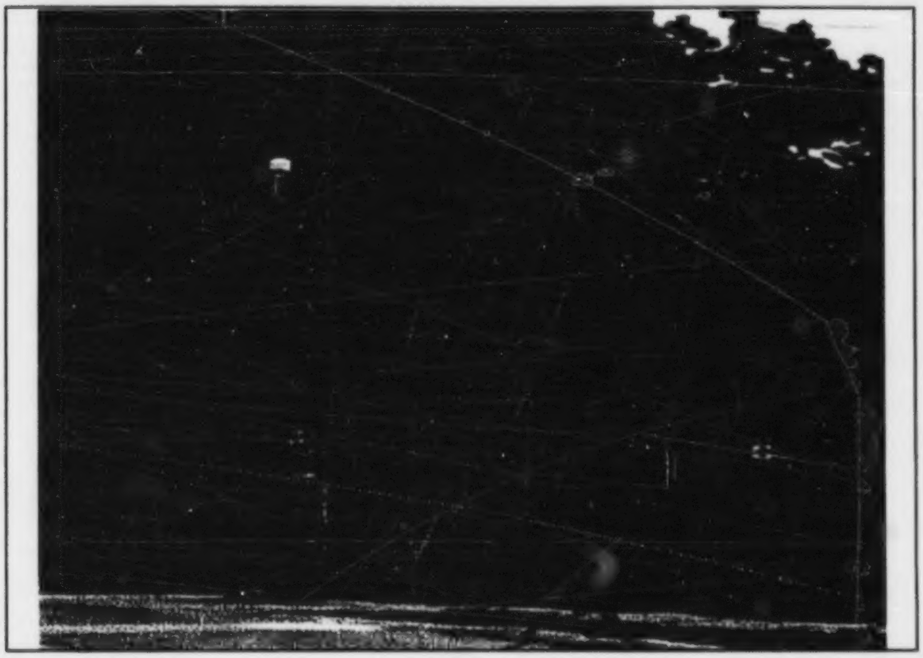
RNS:
wns fuss
over costs
of compliance

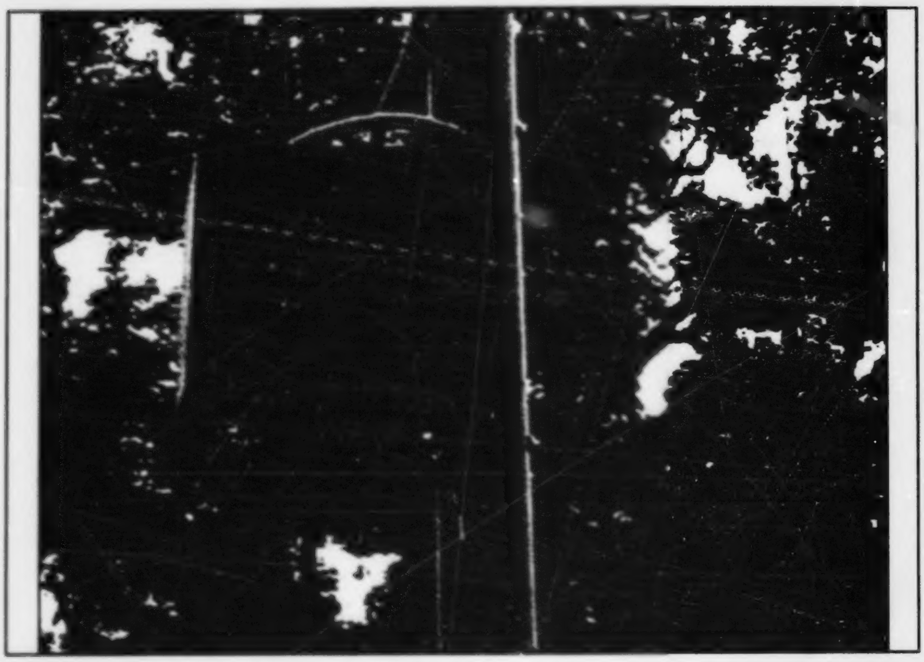


However, the Village of Mundelein is seeking a more reasonable alternative...



Our staff visited Ames, Iowa, in June 1999 to observe an Automated Horn installation.





The Automated Horn provides a more focused blast from the train horn.

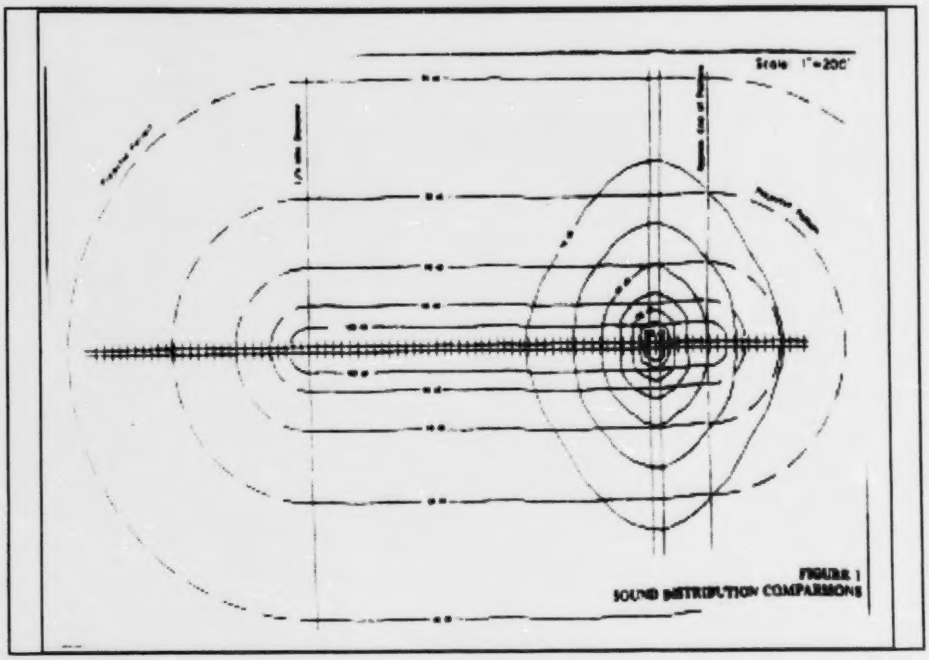
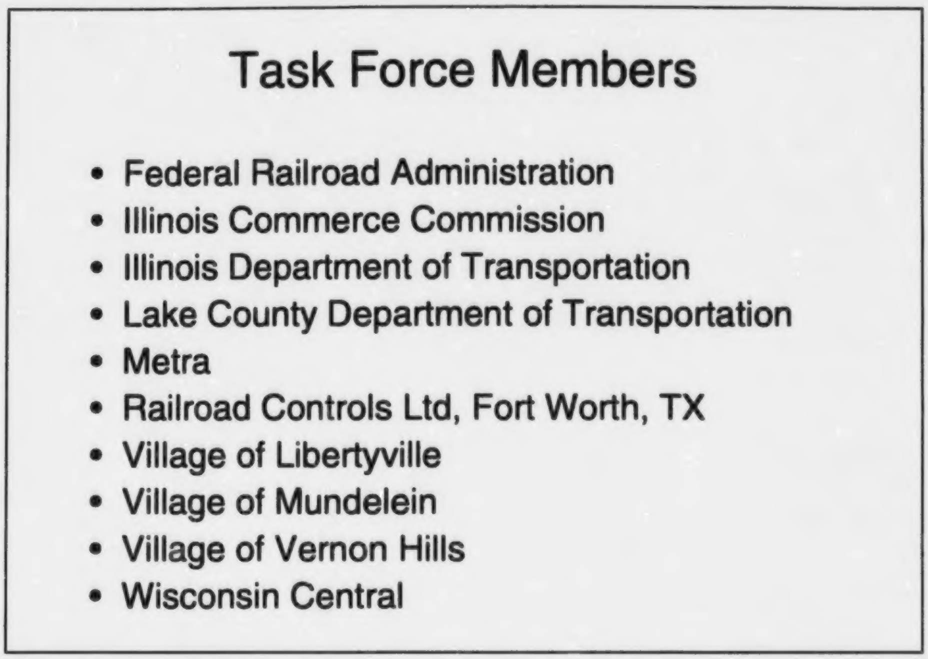


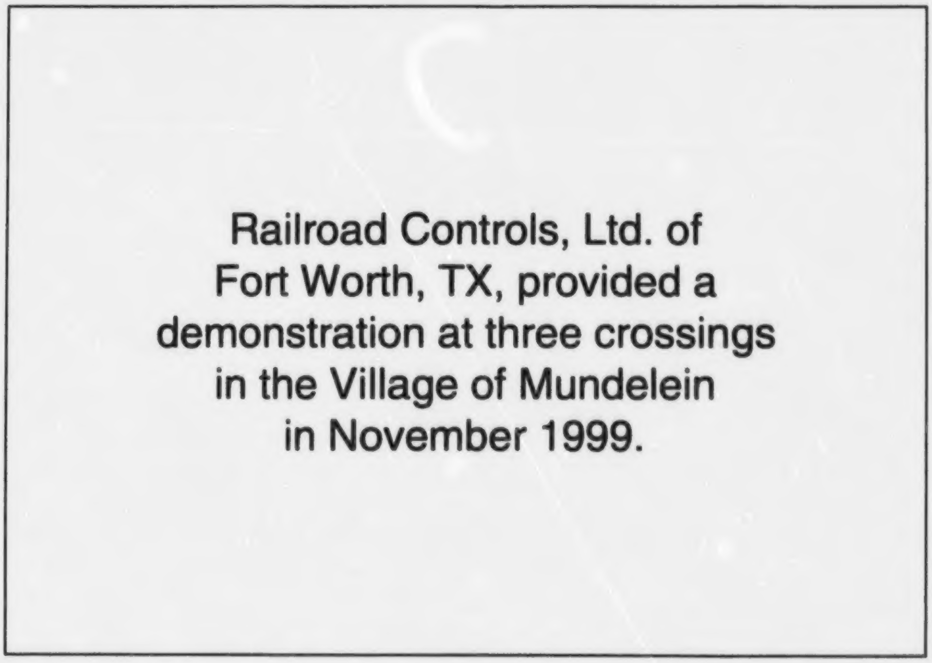
FIGURE 1
SOUND DISTRIBUTION COMPARISONS

Consequently, the Village of Mundelein formed a Task Force to explore the feasibility of implementing the Automated Horn System.

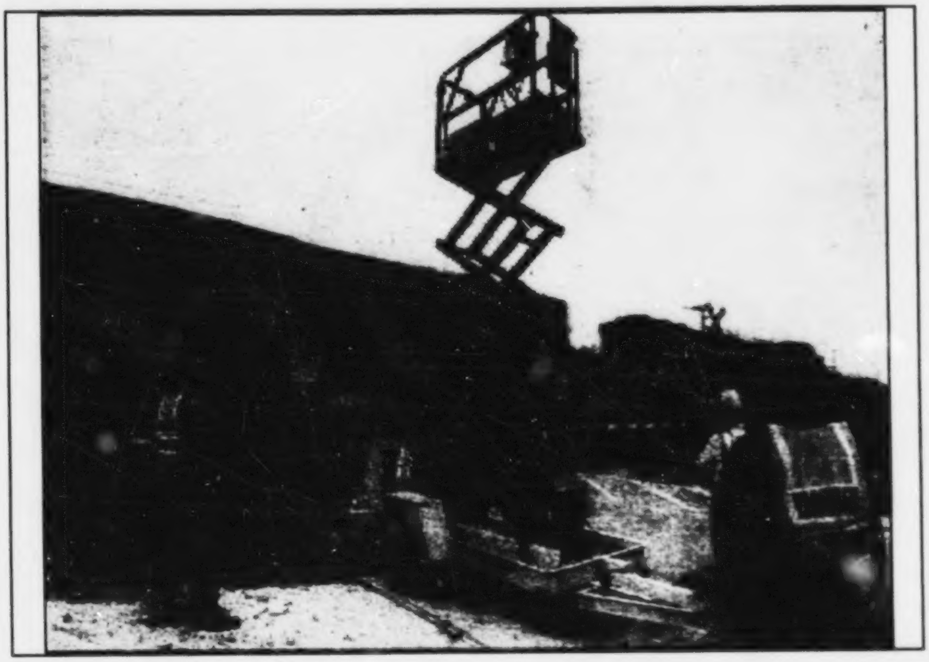


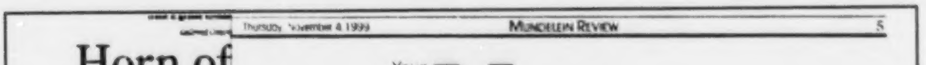
Task Force Members

- Federal Railroad Administration
- Illinois Commerce Commission
- Illinois Department of Transportation
- Lake County Department of Transportation
- Metra
- Railroad Controls Ltd, Fort Worth, TX
- Village of Libertyville
- Village of Mundelein
- Village of Vernon Hills
- Wisconsin Central



Railroad Controls, Ltd. of
Fort Worth, TX, provided a
demonstration at three crossings
in the Village of Mundelein
in November 1999.





Thursday, November 4 1999 Mundelein Review 5

Your Local News

LOCAL REPORT

Horn of

Mundelein wants to be test site for new rail crossing alarm

Village mul

Blowing the whistle

Village seeks to install horn system at rail crossings

Mundelein tested an automated train horn system Monday.

Daily Herald Photo John Starks

Blare may be quieted in Mundelein

By Russell Lissau
Daily Herald Staff Writer

7/13/99

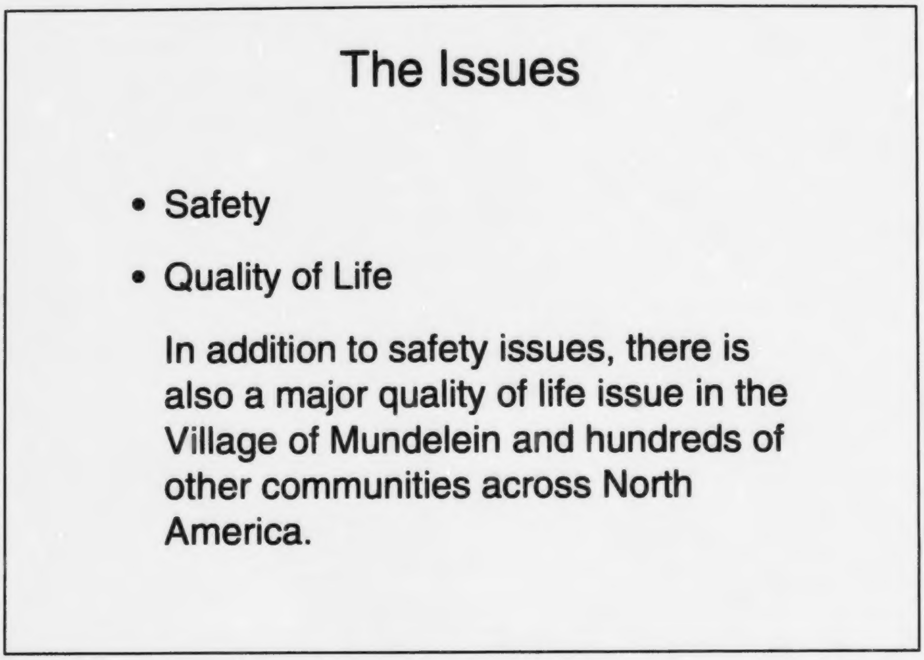
There's nothing quite like being jarred awake in the dead of night by the earsplitting sound of a train whistle. The noise is a common source of complaints in the suburbs, but there isn't much local leaders have been able to do about it.

Mundelein officials, however, may have found a partial solution

"This could be a solution in terms of significant noise reduction and safety enhancement at the crossings."

— Kenneth Marabella, village administrator

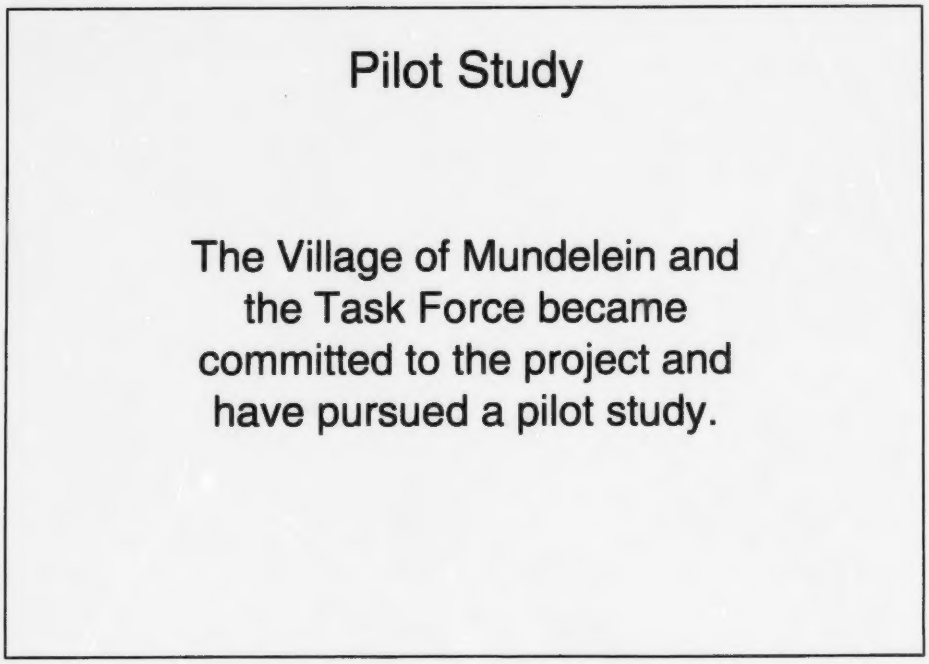
Mundelein considers device to decrease noise from train horns



The Issues

- Safety
- Quality of Life

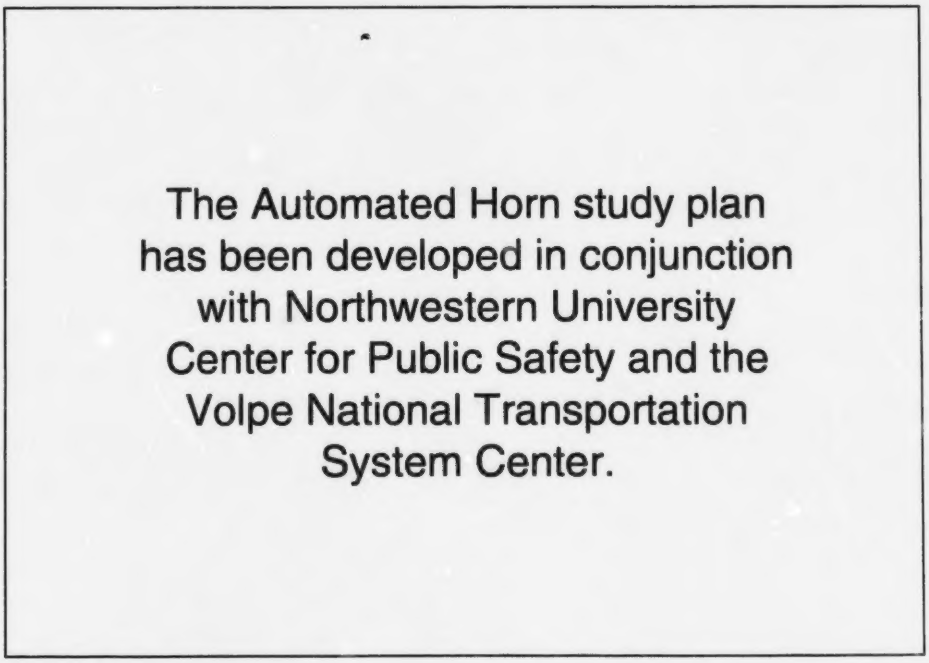
In addition to safety issues, there is also a major quality of life issue in the Village of Mundelein and hundreds of other communities across North America.



Pilot Study

The Village of Mundelein and the Task Force became committed to the project and have pursued a pilot study.

Our cooperative, proactive, multi-jurisdictional approach is designed to promote safety while significantly enhancing quality of life issues.

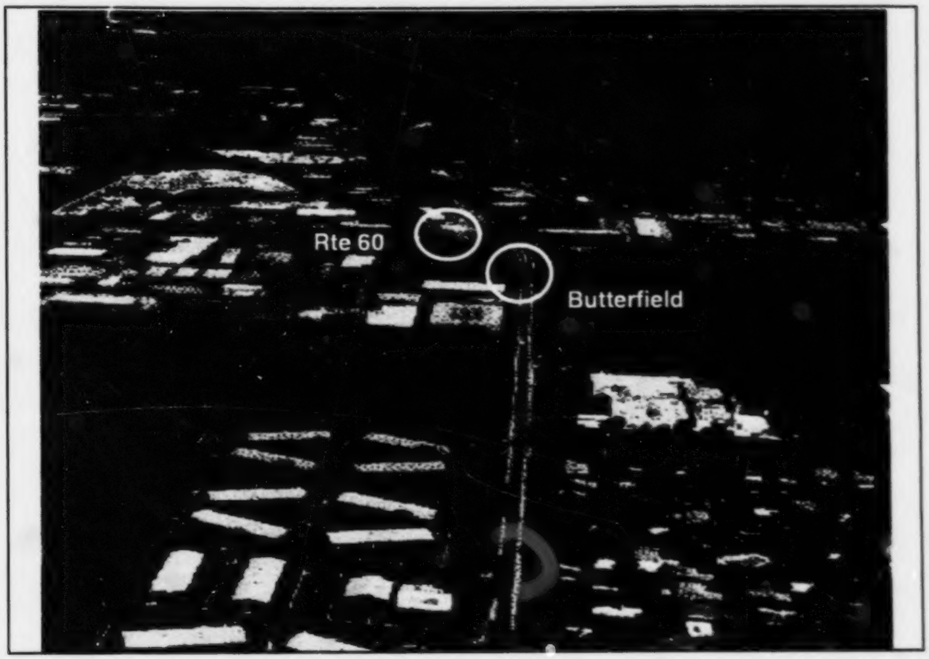


The Automated Horn study plan has been developed in conjunction with Northwestern University Center for Public Safety and the Volpe National Transportation System Center.

Installations

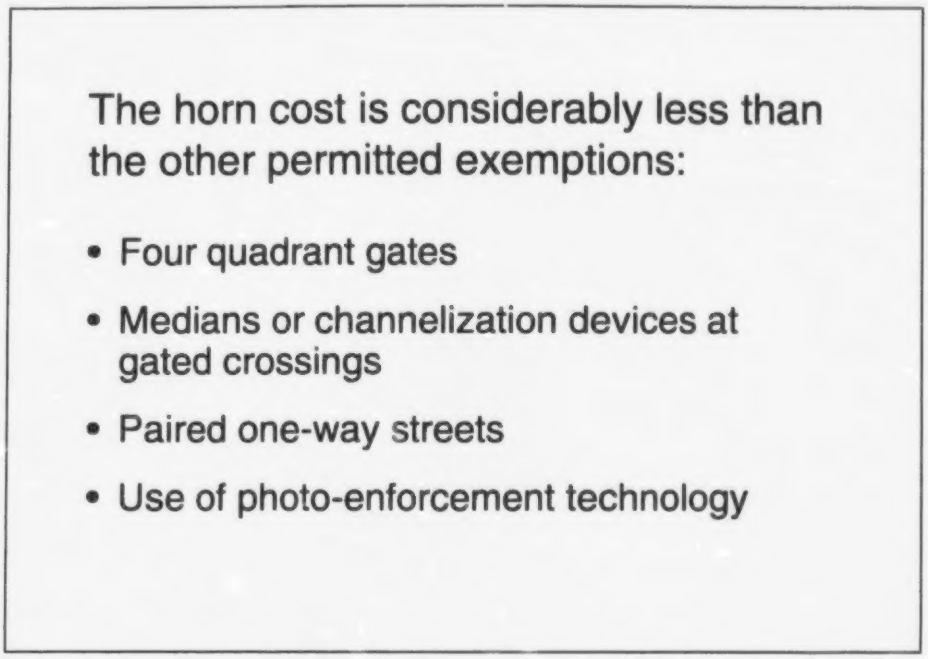
- The Illinois Commerce Commission has agreed to ORDER and pay for the installations of the Automated Horns at the seven local and county roads.
- The Illinois Department of Transportation has agreed to pay for the construction at their two state highways.
- The Wisconsin Central will permit the installations in their right-of-ways.
- The Village of Mundelein will contract for the maintenance of the horns.

Hawley
Park St
X


Rte 60
Butterfield

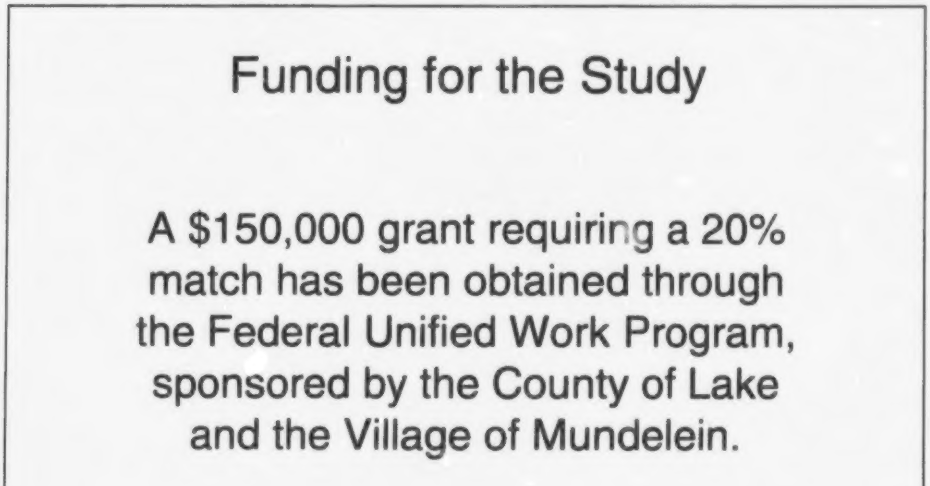
Installation Cost

The cost of construction for all nine crossings from Railroad Controls is $320,150 or an average of $35,572 per crossing.



The horn cost is considerably less than the other permitted exemptions:

- Four quadrant gates
- Medians or channelization devices at gated crossings
- Paired one-way streets
- Use of photo-enforcement technology



Funding for the Study

A $150,000 grant requiring a 20% match has been obtained through the Federal Unified Work Program, sponsored by the County of Lake and the Village of Mundelein.

Sharing the 20% Required Match

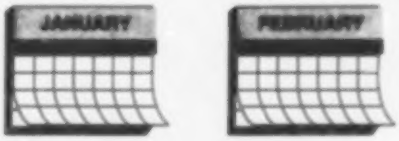
- County of Lake
- Metra
- Railroad Controls, Ltd.
- Village of Libertyville
- Village of Mundelein
- Village of Vernon Hills
- Wisconsin Central

Federal Railroad Administration

The FRA will pay for the Volpe National Transportation System Center role in the project.

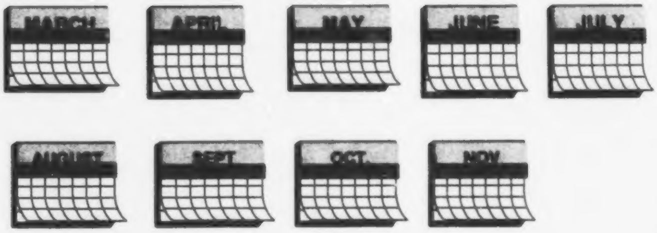
Northwestern University
Center for Public Safety
will conduct the study.

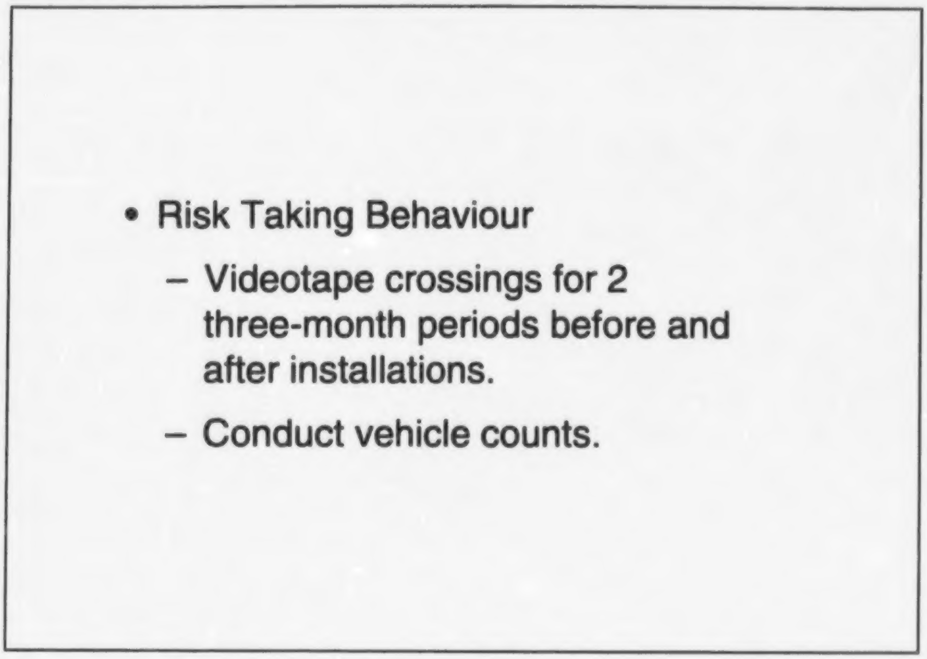
Phase 1
Prepare the Sites


JANUARY
FEBRUARY

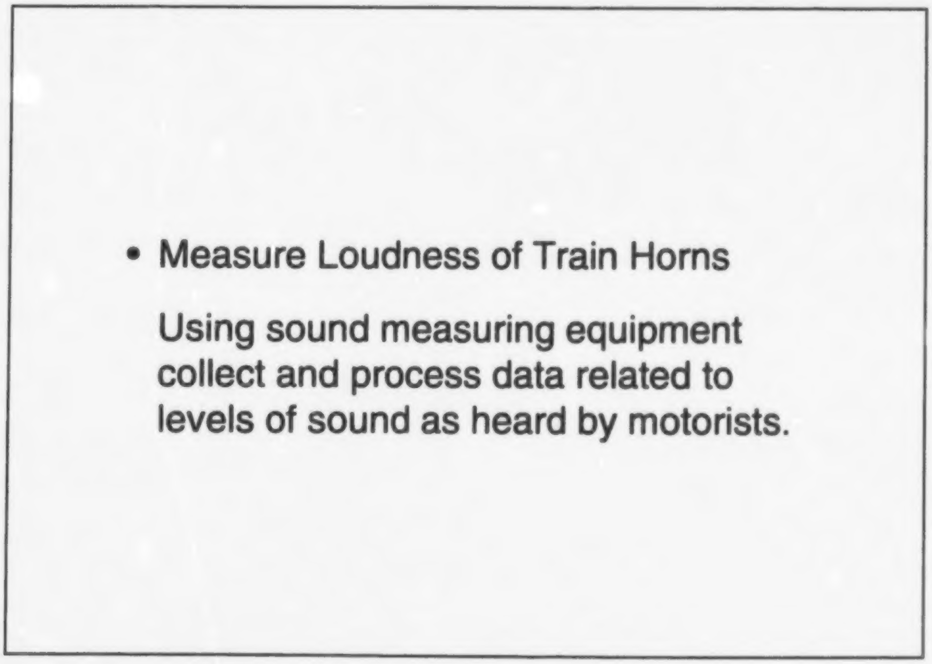
- Set up poles at ***three*** crossings and provide 110 volt AC service.
- Provide relays on the gate control boxes for use by the cameras and horn system.
- Install video cameras and recording equipment.

Phases 2 and 3 Evaluating Effectiveness and Quality of Life


MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPT
OCT.
NOV



- Risk Taking Behaviour
  - Videotape crossings for 2 three-month periods before and after installations.
  - Conduct vehicle counts.



- Measure Loudness of Train Horns

Using sound measuring equipment collect and process data related to levels of sound as heard by motorists.

- Observed Change in Driver Behaviour from the Engineer's View

  After the wayside horns have been in operation, engineers will be surveyed to determine how they perceive safety at the crossings.

- Sound levels

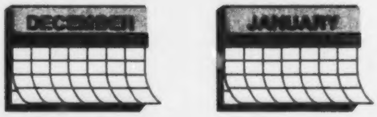
  Sound levels will be measured at selected residential sites radiating from the crossings in Mundelein.

Sound levels will be measured at specific intervals. They will be taken from 500 and 1000 feet and 0.25 and 0.5 miles from the centre of the crossing.

- Survey of Residents

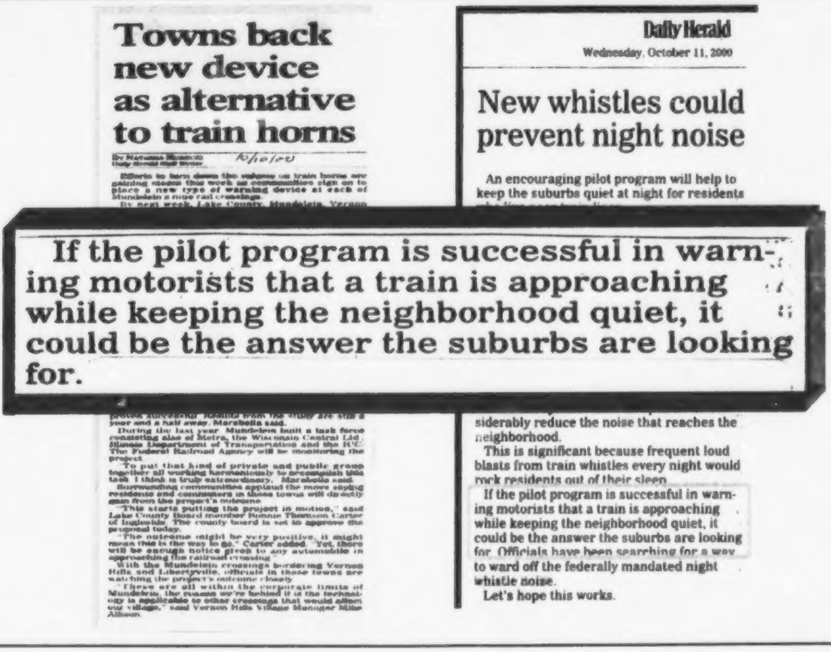
  Residents will then be surveyed to determine how they perceive the sound differences between a horn on a moving train and the fixed automated horns.

Phase 4
Data Analysis /Reporting



- Northwestern will provide monthly status reports.
- Two final reports (before and after) will be produced.
- Distribution to all Task Force members.

News of the study is being welcomed by our residents and the media.



Towns back new device as alternative to train horns

10/10/00

Daily Herald

Wednesday, October 11, 2000

New whistles could prevent night noise

An encouraging pilot program will help to keep the suburbs quiet at night for residents

If the pilot program is successful in warning motorists that a train is approaching while keeping the neighborhood quiet, it could be the answer the suburbs are looking for.

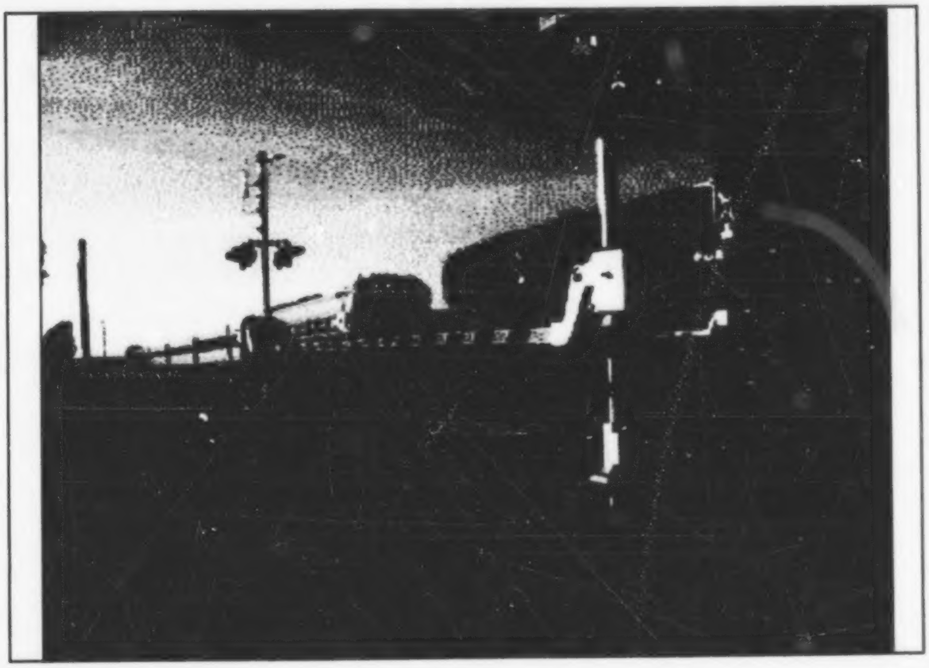
siderably reduce the noise that reaches the neighborhood.

This is significant because frequent loud blasts from train whistles every night would rock residents out of their sleep.

If the pilot program is successful in warning motorists that a train is approaching while keeping the neighborhood quiet, it could be the answer the suburbs are looking for. Officials have been searching for a way to ward off the federally mandated night whistle noise.

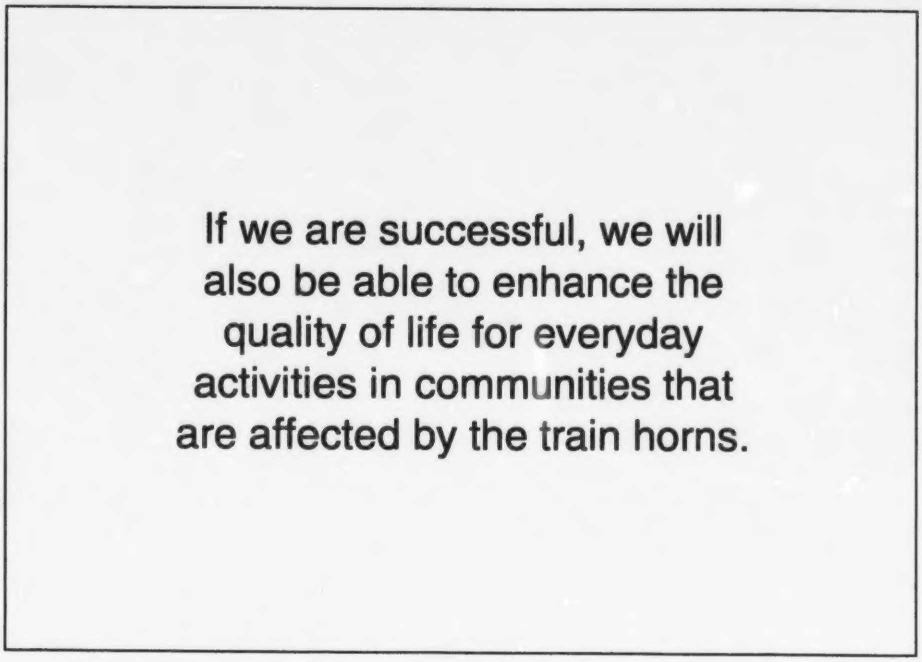
Let's hope this works.

People understand the essential role that railroad transport plays…

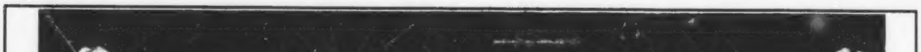


(C) Matt Donnelly

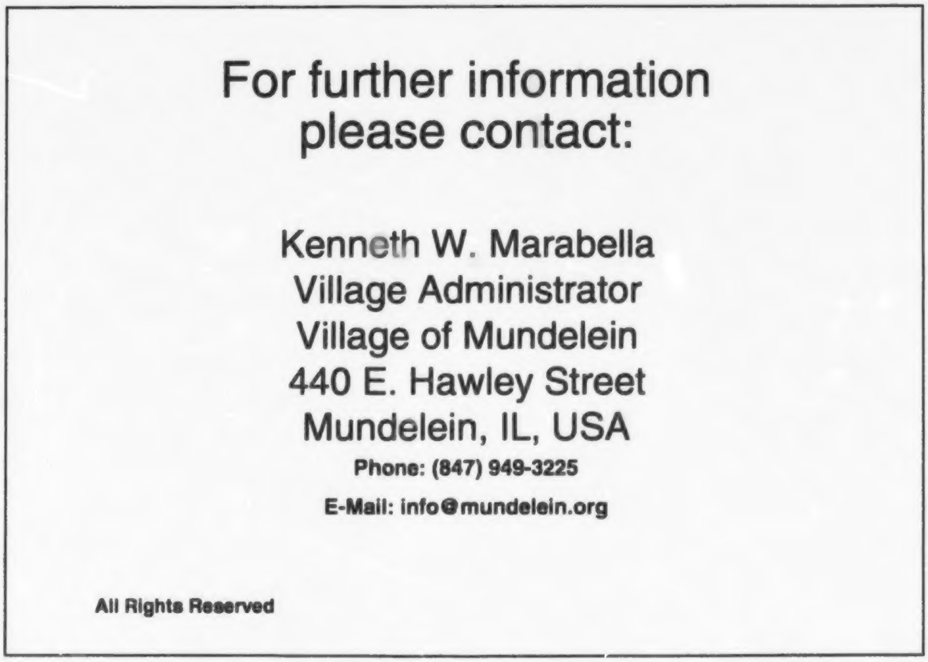
They just want to live their lives peaceably, and without disruption.



If we are successful, we will also be able to enhance the quality of life for everyday activities in communities that are affected by the train horns.



Thank you for the opportunity to share this information with you today.



For further information please contact:

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Village Administrator
Village of Mundelein
440 E. Hawley Street
Mundelein, IL, USA
Phone: (847) 949-3225
E-Mail: info@mundelein.org

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Prepared for:

Transport Canada's
Second Annual Workshop
On Rail-Highway
Grade Crossing Research

Prepared by the Office of the Village Administrator

Marie Cecchi, Village Administrator's Office	Producer
Kenneth Marabella, Village Administrator	Director

Motor Carrier Safety Ratings and Grade Crossing Safety Contraventions

Louis-Paul Tardif
L.-P. Tardif & Associés
Ottawa, Ontario

SUMMARY

Under new Canadian rules, motor carriers will need a safety fitness certificate to hold an operating license. This will require that each jurisdiction establish a carrier profile as part of their safety rating process. The federal government is also developing regulations under the Motor Vehicle Transport Act, 1987, to provide a federal umbrella regulatory regime for interprovincial motor carriers. Furthermore, with the new federal Contravention Act, the federal government can also provide regulatory authority to provincial governments for summary convictions for infractions committed under federal regulations or legislation.

Each carrier's profile will contain information on their infractions, convictions, and accidents. If a motor carrier loses enough points to reach an unsatisfactory rating and does not rectify the situation, a jurisdiction can remove its operating authority. These safety ratings apply to motor carriers transporting freight or passengers and operating commercial vehicles. These vehicles are generally over 4 500 kg in gross vehicle weight.

The statistical evidence points towards a low frequency of accidents and events involving commercial vehicles at grade crossings. However, of all vehicles involved in accidents at grade crossings, commercial vehicles represent a higher risk in view of the cargo they may carry, e.g., dangerous goods, or the number of passengers on board, e.g., a school bus or a motor coach. Any accident at a grade crossing that involves such vehicles can therefore be of greater severity than those involving other road vehicles. Furthermore, a major impact between a road vehicle and a train may cause a derailment.

The objective of this project is to catalogue grade crossing infractions identified under highway traffic acts and regulations and then determine the treatment given to those infractions in establishing a motor carrier rating. The project will also investigate the link between commercial drivers' infractions at grade crossings and motor carrier profiles. It will look at how these issues are dealt with in the United States in the hope that reciprocal treatment can be achieved. The project will determine how aware regulators and the motor carrier industry are of the linkage between grade crossing infractions and motor profiles. Finally, the project will recommend measures to enhance safety and achieve national uniformity of treatment.

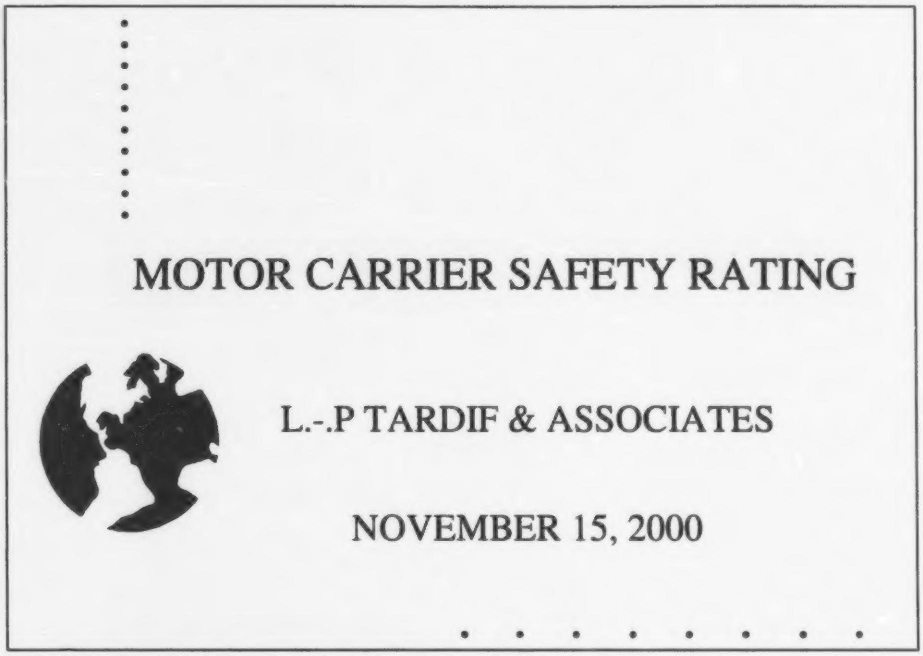
SOMMAIRE

De nouvelles règles seront bientôt adoptées au Canada, en vertu desquelles les transporteurs routiers devront obtenir un certificat d'aptitude en matière de sécurité pour détenir une licence d'exploitation. Chaque administration devra alors attribuer aux transporteurs des cotes de sécurité et, à cette fin, établir leur profil de sécurité. Le gouvernement fédéral est également à élaborer un règlement, en vertu de la *Loi de 1987 sur les transports routiers*, qui établira sous un chapeau fédéral un régime réglementaire visant les transporteurs extra-provinciaux. Enfin, la nouvelle *Loi sur les contraventions* permet au gouvernement fédéral de conférer aux provinces l'autorité réglementaire de procéder à des déclarations de culpabilité par procédure sommaire dans des cas d'infractions commises en vertu de lois ou des règlements fédéraux.

Les profils de transporteurs contiendront des données sur les infractions, les déclarations de culpabilité et les accidents. Si un transporteur routier perd tellement de points que sa cote devient insatisfaisante et qu'il ne remédie pas à la situation, il pourra se voir retirer sa licence d'exploitation. Ces cotes de sécurité s'appliquent aux transporteurs de marchandises et de passagers, et aux exploitants de véhicules utilitaires. Tous ces véhicules ont un poids nominal brut généralement supérieur à 4 500 kg.

Les données statistiques révèlent un faible taux d'accidents et d'incidents mettant en cause des véhicules utilitaires aux passages à niveau. Mais, parmi tous les véhicules impliqués dans des accidents aux passages à niveau, les véhicules utilitaires représentent un risque accru, en raison de la cargaison (marchandises dangereuses, p. ex.) ou du nombre de passagers (s'il s'agit, p. ex., d'un autobus d'écoliers ou d'un autocar) qu'ils transportent. Ainsi, tout accident à un passage à niveau mettant en cause ces véhicules pose un risque plus grave qu'un accident impliquant d'autres types de véhicules routiers. Sans compter qu'un fort impact entre un véhicule routier et un train peut causer un déraillement.

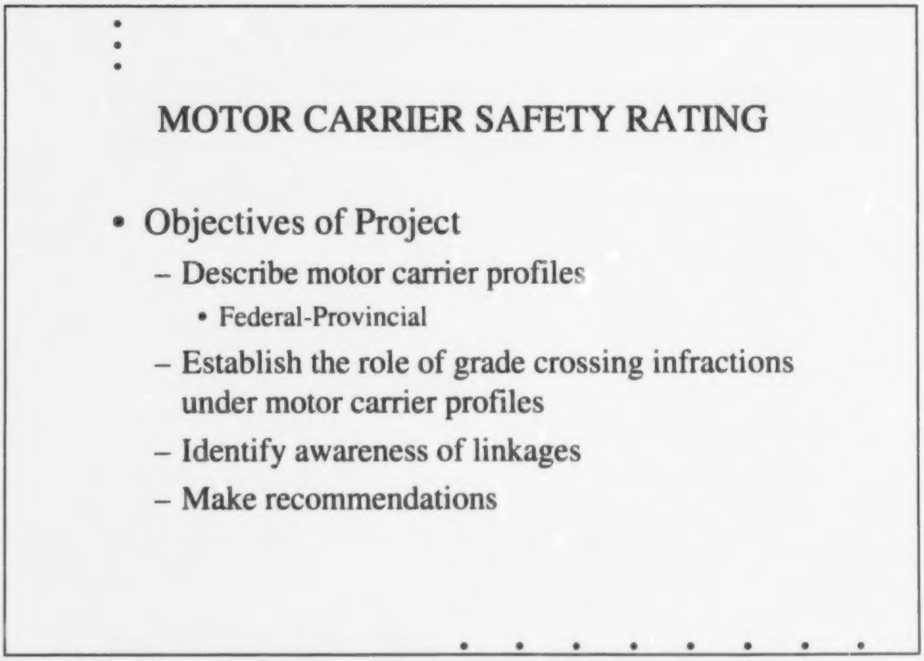
Ce projet a pour objectifs de cataloguer les infractions aux passages à niveau prévues par les codes de la route et de déterminer le rôle joué par ces infractions lors de l'établissement de la cote de sécurité d'un transporteur routier. Les chercheurs étudieront en outre le lien entre les infractions commises par les conducteurs de véhicules utilitaires aux passages à niveau et les profils des transporteurs routiers. Ils examineront de quelle façon on traite ces questions aux États-Unis, dans l'espoir qu'un arrangement de réciprocité puisse être conclu. Le projet permettra de voir dans quelle mesure les organismes de réglementation et l'industrie du transport routier sont conscients du lien qui existe entre les infractions aux passages à niveau et les profils des transporteurs. Finalement, l'équipe de recherche recommandera des mesures pour accroître la sécurité et uniformiser le traitement des infractions à l'échelle nationale.



MOTOR CARRIER SAFETY RATING

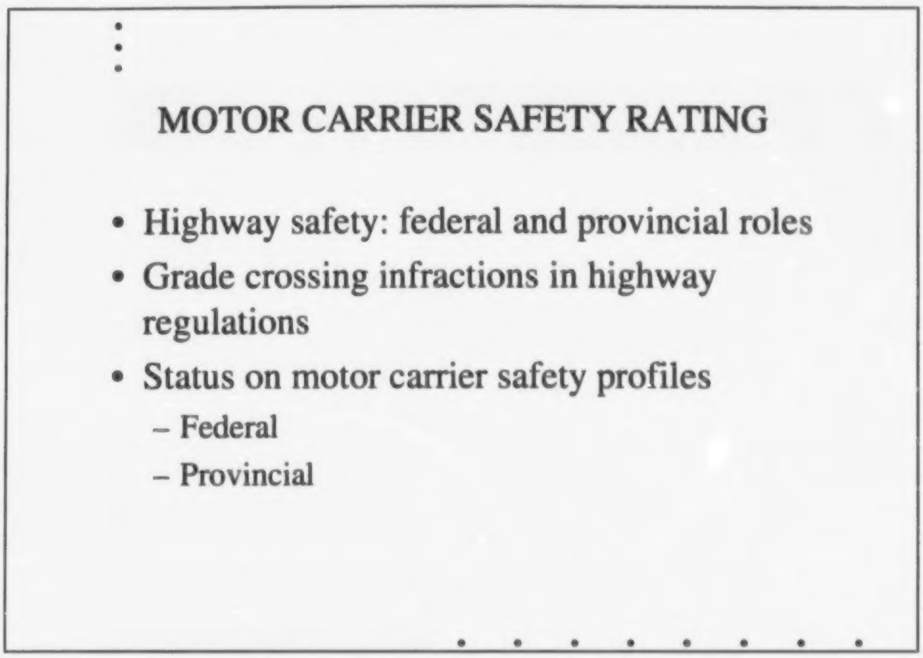
L.-.P TARDIF & ASSOCIATES

NOVEMBER 15, 2000



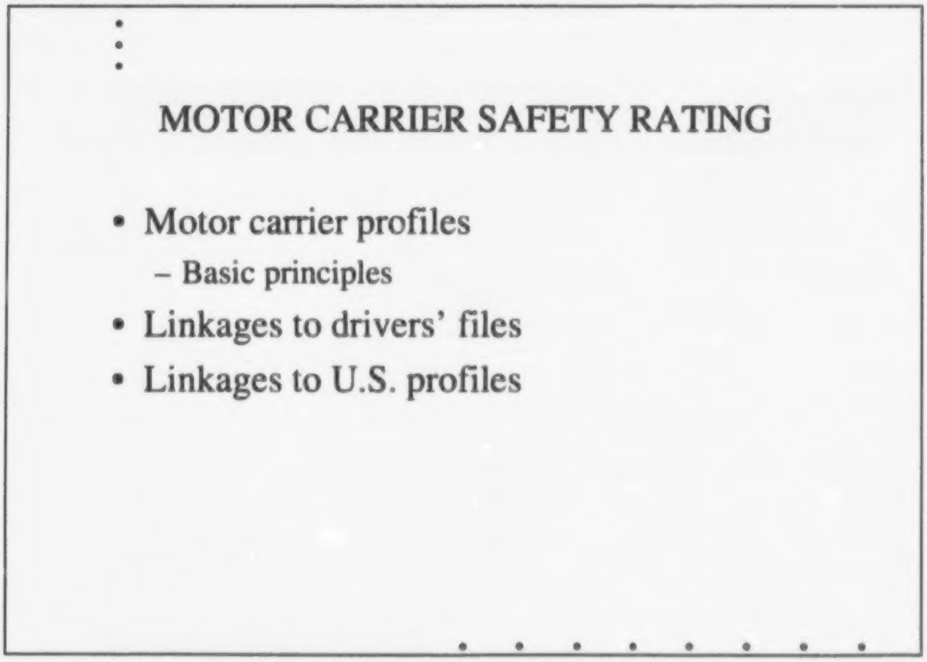
MOTOR CARRIER SAFETY RATING

- Objectives of Project
  - Describe motor carrier profiles
    - Federal-Provincial
  - Establish the role of grade crossing infractions under motor carrier profiles
  - Identify awareness of linkages
  - Make recommendations



MOTOR CARRIER SAFETY RATING

- Highway safety: federal and provincial roles
- Grade crossing infractions in highway regulations
- Status on motor carrier safety profiles
  - Federal
  - Provincial



MOTOR CARRIER SAFETY RATING

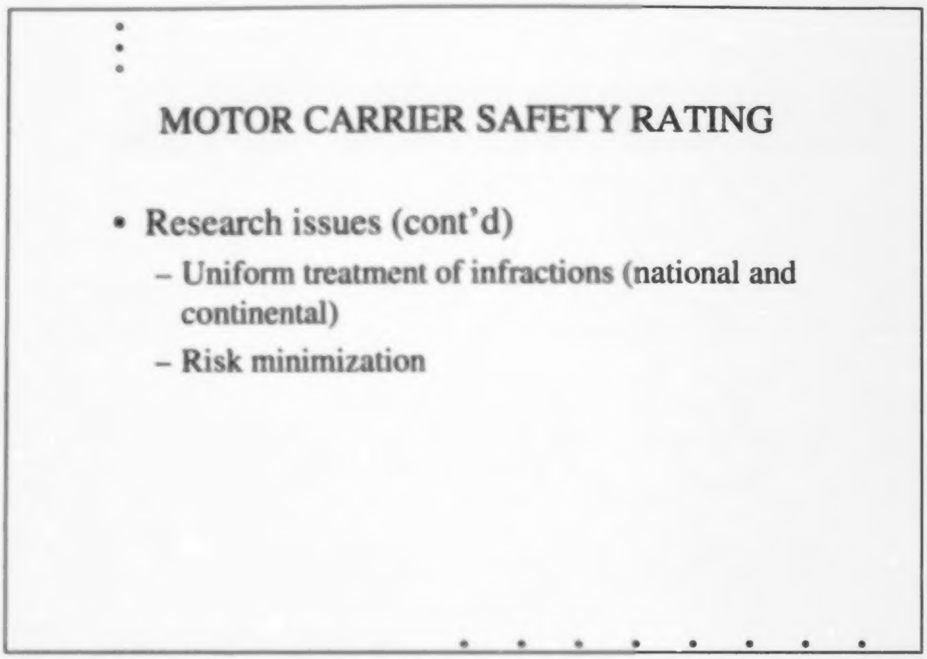
- Motor carrier profiles
  - Basic principles
- Linkages to drivers' files
- Linkages to U.S. profiles

MOTOR CARRIER SAFETY RATING

- Relevance of federal recognition of grade crossing infractions
  - Case of criminal code infractions recognized under existing motor carrier profiles
- Contraventions act

MOTOR CARRIER SAFETY RATING

- Research issues
  - Severity of treatment
  - Behavioural modification
    - Public knowledge
    - Motor carrier's information
      - the insurance aspect
      - the driver



MOTOR CARRIER SAFETY RATING

- Research issues (cont’d)
  - Uniform treatment of infractions (national and continental)
  - Risk minimization

MOTOR CARRIER SAFETY RATING

- Statistical evidence
  - Few accidents
  - 10% of all vehicles
- High risk & exposure
- Small steps towards resolution of “modal conflict”

Second Train Warning Signs for Light Rail

Vernon G. Hartsock
Maryland Mass Transit Administration
Baltimore, Maryland

SUMMARY

The United States Federal Transit Administration (FTA) issued a grant to the Maryland Mass Transit Administration (MTA) to fund a study in the area of second train warning signs for light rail transit systems. The problem of second train movements through rail-highway intersections creates a confusing and potentially dangerous situation for motorists and pedestrians. This paper documents the efforts of the MTA to develop and evaluate a second train warning system. The test site for the project is the Timonium Road crossing in Northern Baltimore County, Maryland, along the Baltimore Central Light Rail Line. The Timonium Road crossing is a two-track, signalized crossing that consists of gates, flashing lights, and a warning bell. The second train warning system consists of variable message signs and strobe lights that activate upon detection of a second train. The warning system provides information that a second train is approaching the rail-highway intersection. Video data records were compiled showing motorist behaviour before and after installation of the warning system. Analysis of records indicates a reduction in risky behaviour during second train events coinciding with the presence of the warning system. A draft report on the project has been furnished to the FTA. Comments were received and a final report is in production.

SOMMAIRE

La Federal Transit Administration (FTA) des États-Unis a accordé une subvention à la Mass Transit Administration (MTA) du Maryland pour le financement d'une étude sur les dispositifs d'avertissement de l'approche d'un autre train destinés à un réseau de trains légers sur rail. Les mouvements de trains multiples aux passages à niveau prêtent à la confusion et créent une situation potentiellement dangereuse pour les automobilistes et les piétons. Ce document rend compte de la mise au point et de l'évaluation, par la MTA, d'un système d'avertissement de l'approche d'un autre train. L'étude a eu lieu au passage à niveau de Timonium Road dans le comté Northern Baltimore, au Maryland, sur la ligne Baltimore Central. Ce passage à niveau de deux voies ferrées est signalisé et comporte des barrières, des feux clignotants et une cloche d'avertissement. Le dispositif d'avertissement de l'approche d'un autre train est constitué de panneaux à messages variables et de feux à éclats qui s'activent à l'arrivée d'un deuxième train. Ce dispositif indique explicitement qu'un autre train s'approche du passage à niveau. La collecte de données vidéo a permis d'étudier le comportement des automobilistes avant et après l'installation du système d'avertissement. L'analyse des enregistrements révèle une diminution des comportements à risque à l'approche d'un autre train,

en présence du dispositif d'avertissement. Un avant-projet de rapport d'étude a été remis à la FTA. Les commentaires ont été reçus et le rapport final est en préparation.

INTRODUCTION

The possibility of encountering a second train while stopped at a rail-highway intersection presents a significant danger to the motorist and to the pedestrian. When a train passes through a crossing and the gates remain down, an opportunity exists to be struck by a second train coming in the opposite direction from that of the first train. A motorist or pedestrian who cannot see a second train approaching (especially if they are looking in the direction from which the first train approached) may decide to ignore the gates and cross the intersection.

In mid 1996, the Federal Transit Administration (FTA) invited transit agencies throughout the country to participate in a safety-related research project called the Second Train Coming Warning Signal Demonstration Project A-5A. The objective of the project was to determine whether active warning signs could improve safety at light rail-highway intersections during second train coming incidents. In September of 1996, the Maryland MTA applied for the grant. In 1997, the Federal Transit Administration (FTA) issued a grant to the Maryland MTA to design, build, and study the effectiveness of a prototype second train warning sign for use at light rail-highway intersections. A similar grant was also issued to the Los Angeles California Metro. On September 4, 1998, the Maryland MTA activated its prototype second train coming warning system.

The following information details the results of the study.

DEFINITION OF SECOND TRAIN COMING (Refer to Figure 1)

The situation in which two trains moving from opposite directions activate grade crossing equipment is known as a ***second train coming*** incident. During a second train coming (STC) incident, two possible scenarios would be presented to the motorist. The first scenario occurs as follows: when one train approaches the crossing, the gates go down, then a second train approaches the crossing from the opposite direction. A motorist stopped at the crossing would observe the passing of the first train and would expect to see the crossing gates begin to ascend to their vertical position. However, the crossing gates would remain horizontal because of the unseen approach of the second train. Under this circumstance, the motorist might assume the crossing equipment has failed and try to go around the gates, only to encounter the second train coming at 50 mph. It is interesting to note that motorists might look for a second train during this event, but the natural tendency might be to look in the direction following the first train. Under the second scenario, the gates would begin to ascend following the passing of the first train. Within seconds, the gates reverse direction and start coming back down again due to the approach of a second train. The factor that determines which scenario will prevail is based upon the actual crossing point of the two trains. Figure 1 provides a diagram showing two trains relative to the Timonium Road crossing. The figure shows the limits within which the grade crossing equipment is sensitive to the presence of trains. These limits are approximately 1760 ft. prior to the crossing and 528 ft. after the crossing. If one train is within these limits and a second train begins to approach from the opposite direction, the STC incident occurs.

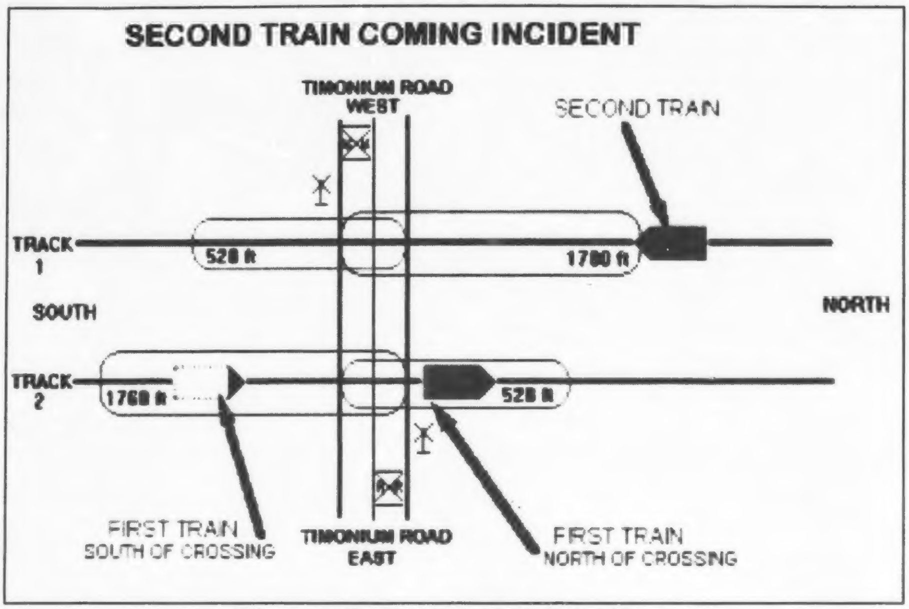

SECOND TRAIN COMING INCIDENT
TIMONIUM ROAD WEST
SECOND TRAIN
TRACK 1
528 ft
1760 ft
SOUTH
NORTH
TRACK 2
1760 ft
528 ft
FIRST TRAIN SOUTH OF CROSSING
TIMONIUM ROAD EAST
FIRST TRAIN NORTH OF CROSSING

Figure 1. Definition of STC Incident

THE MARYLAND MTA'S SECOND TRAIN PROJECT

The Maryland MTA received a $200,000 grant in March of 1997 from the FTA to develop and evaluate a second train warning system. The goals of the project included:

- To design and demonstrate an active warning sign to alert motorists that a second train is coming while they are stopped at a light rail grade crossing
- To measure the effectiveness of the sign through the observation of motorist behaviour during STC events both before and after sign installation

To accomplish these goals, the following tasks were performed.

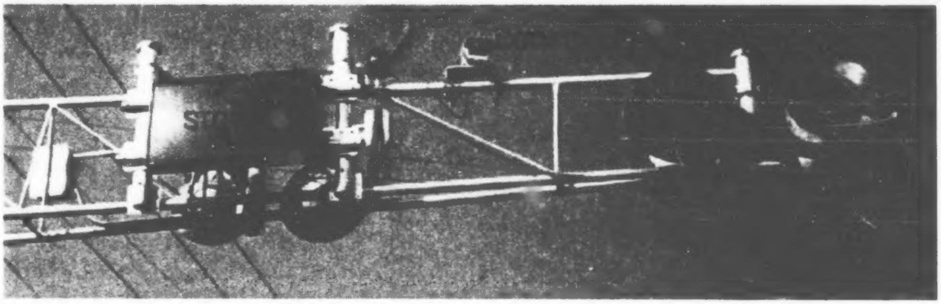
DEMONSTRATION SITE SELECTION – TIMONIUM ROAD GRADE CROSSING

The operating schedule for the Baltimore Central Light Rail Line (CLRL) is such that a second train incident frequently takes place at the Timonium Road grade crossing. During such incidents, trains pass each other just north of the grade crossing; therefore, the grade crossing equipment is frequently activated by two trains at close to the same time. Approximately 10 out of 70 train movements per day constitute second train incidents. The Timonium grade crossing is a two-track crossing in Northern Baltimore County on the CLRL. Timonium Road provides passage between a major interstate highway (I83) and a heavily travelled business road (York Road) and experiences a high traffic volume during morning, afternoon, and evening hours. In addition, the entrance to the Maryland State Fairgrounds is located immediately adjacent to the crossing. The crossing is signalized and contains warning equipment, including a bell, flashing lights, and crossing gates. The

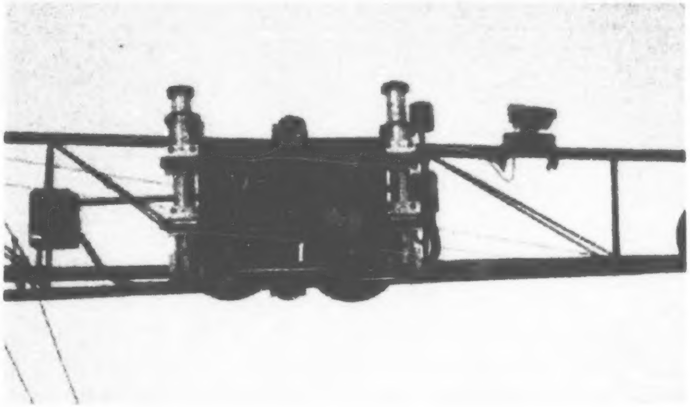
Timonium crossing is designed to support train-operating speeds of 50 mph while maintaining a 24-second warning time. The Timonium crossing was selected for the demonstration site because of its characteristics, such as multiple tracks, a high traffic volume, and frequent STC incidents.

SIGN MESSAGE SELECTION AND PROCUREMENT (Refer to Figures 2 and 3)

The STC sign must display both text and graphic information; therefore, variable message LED signs were selected. The colour selected for the LEDs was amber, in compliance with state guidelines for warning signs. In addition to the STC message signs, amber strobe lights were installed near each STC sign. The strobe lights are activated at the same time as the STC signs and are intended to attract the attention of motorists so that they look at the STC message sign. The signs were mounted on the overhead cantilever structures. The cantilevers are located just ahead of each gate arm mechanism. Mounting the signs on the rear of each cantilever made them clearly viewable by motorists from across the tracks. The objective was to focus the signs for optimal viewing by the first and second cars stopped behind the crossing gates. The distance from each sign

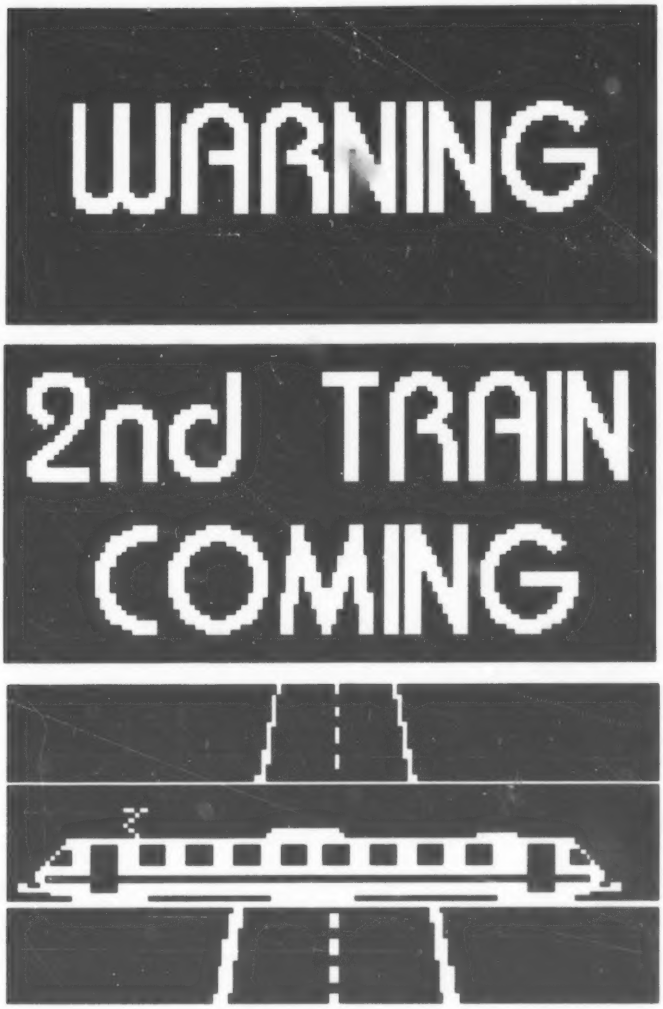


STC GRAPHIC SIGN, STROBE LIGHT, CCTV CAMERA (1 OF 2)



STC GRAPHIC SIGN IN OPERATION

Figure 2. Site Photos



PART 1

Text message
flashes for two seconds

PART 2

Text message
remains on for two seconds

PART 3

Graphic message
Five-second animation showing two trains moving through the grade crossing
1 of 128 frames shown

Figure 3. Three Parts of STC Message

to the windshield of the first car is about 50 feet. A structural analysis was performed to determine that the signs could be safely mounted in this fashion. The variable message LED signs are programmed with a three-part graphic/text message. Part one displays the flashing text, **WARNING,** for a period of two seconds. Part 2 displays the steady text, **2nd TRAIN COMING,** for a period of two seconds. Part 3 consists of a five-second animation showing two trains moving through the grade crossing from opposite directions. The message is designed to repeat itself until both trains are clear of the crossing. The graphics for the message are based on concepts developed through a study by the Los Angeles Metro. The warning message was developed in cooperation with representatives from the Maryland State Highway Administration and the Baltimore County Government. The manufacturer of the LED signs was Action Media Technologies, Inc., of Chatsworth, California.

RAILROAD SIGNALS CIRCUITRY MODIFICATION (Refer to Figure 4)

The railroad signals system at the test site has been modified with additional vital relay logic circuits to detect the presence of two trains and to control the STC signs. Figure 4 identifies the track circuits associated with the grade crossing and provides a logic diagram equivalent of the signals circuit modifications. The northbound and southbound illustrations depict the possible track circuit occupancy conditions during which an STC event could occur. For example, in the southbound STC illustration, an STC event will be detected if the southbound LRV enters track circuit

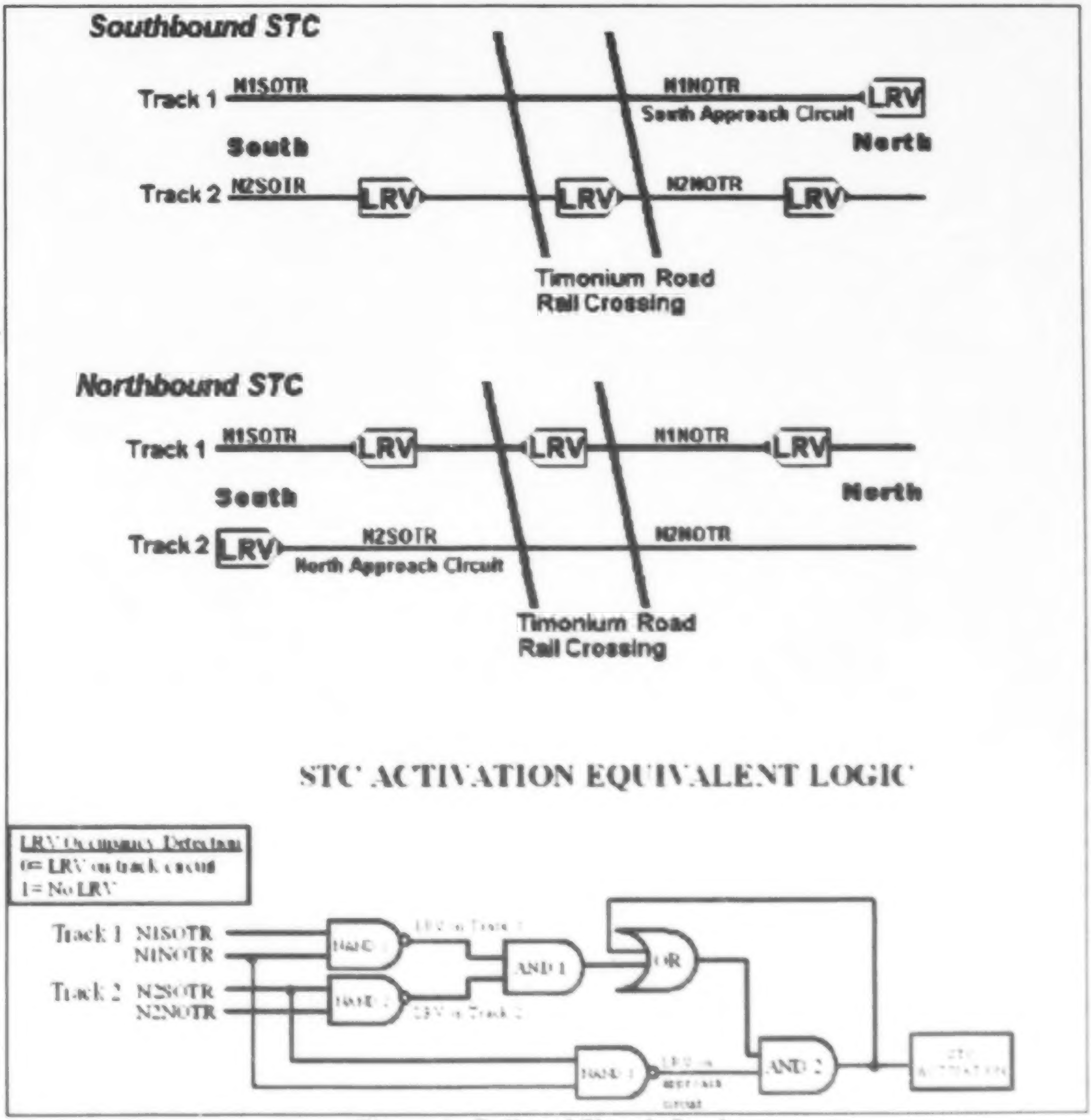

Southbound STC
Track 1
N1SOTR
N1NOTR
South Approach Circuit
LRV
South
North
Track 2
N2SOTR
LRV
LRV
N2NOTR
LRV
Timonium Road
Rail Crossing
Northbound STC
Track 1
N1SOTR
LRV
LRV
N1NOTR
LRV
South
North
Track 2
LRV
N2SOTR
North Approach Circuit
N2NOTR
Timonium Road
Rail Crossing
STC ACTIVATION EQUIVALENT LOGIC
LRV Occupancy Detection
0= LRV on track circuit
1= No LRV
Track 1 N1SOTR
N1NOTR
Track 2 N2SOTR
N2NOTR
NAND 1
LRV in Track 1
AND 1
OR
NAND 2
LRV in Track 2
NAND 3
LRV in approach circuit
AND 2
STC ACTIVATION

Figure 4 . Railroad Signals Logic

N1NOTR (the south approach circuit) at the same time that a northbound LRV occupies either track circuits N2SOTR, N2NOTR, or both. Note that both track circuits for a particular track are occupied when an LRV is present at the intersection of the grade crossing. The "STC Activation Equivalent Logic" is intended to show how the circuitry operates. It is not meant to be interpreted as a schematic diagram of the actual circuitry. Observe that the inputs to logic gate NAND 1 consists of track circuit occupancy relative to track 1 and gate NAND 2 receives inputs from track 2. Track occupancy is represented by a logic 0 (low). The output of gate NAND 1 will be logic 1 (high) whenever occupancy is detected on either or both of the track circuits for track 1. Gate NAND 2 will have an output of logic 1 whenever occupancy is detected on either or both of the track circuits for track 2. Gate AND 1 will produce a logic 1 output only if gates NAND 1 and NAND 2 indicate track occupancy for both track 1 and track 2 at the same time. Therefore, gate AND 1 will have a logic 1 output at the beginning of an STC event. Logic gates OR, AND 2, and NAND 3 form a type of memory circuit to prolong the STC activation until the second train clears its approach track circuit. Gate NAND 3 receives inputs from both the north approach circuit and the south approach circuit and will have a logic 1 output whenever an LRV is on the approach to the crossing. Gate AND 2 will have a logic 1 output whenever an LRV is on the approach to the crossing and when two trains are occupying the grade crossing track circuits. Once gate AND 2 has a logic 1 output, the STC activation occurs and gate OR is forced to maintain a logic 1 output via the feedback to its input (gate OR is disabled). Gate OR is disabled to maintain the STC activation should the first LRV clear both of its track circuits before the second LRV clears the grade crossing.

ACTIVATION OF NEW ACTIVE STC WARNING SIGNS

On September 4, 1998, the MTA activated the STC warning system. When two trains are detected within the limits of the grade crossing detection circuits (refer to Figure 1), the strobe lights flash and the STC signs display their warning message. The STC warning system displays its warning until both trains are clear of the grade crossing.

PUBLIC INFORMATION PLAN

A press release covering the project was issued by the MTA just prior to the activation of the STC warning system. Several television, newspaper, and radio news agencies responded to the press release and conducted interviews to inform the public concerning the new signs. Letters were sent detailing the project to local government representatives and to the local businesses in the area of the test site.

A flier containing a mail-back survey was mass mailed to 10,000 residents in the vicinity of the test site. The flier explains the STC project and identifies where it is being tested. Over 1100 surveys were returned and the responses were tabulated. The survey questions, along with the tabulated responses are as follows:

1. If you have seen the STC system in operation, did it effectively warn you that a second train was coming from the opposite direction?
   Response: 89% Yes

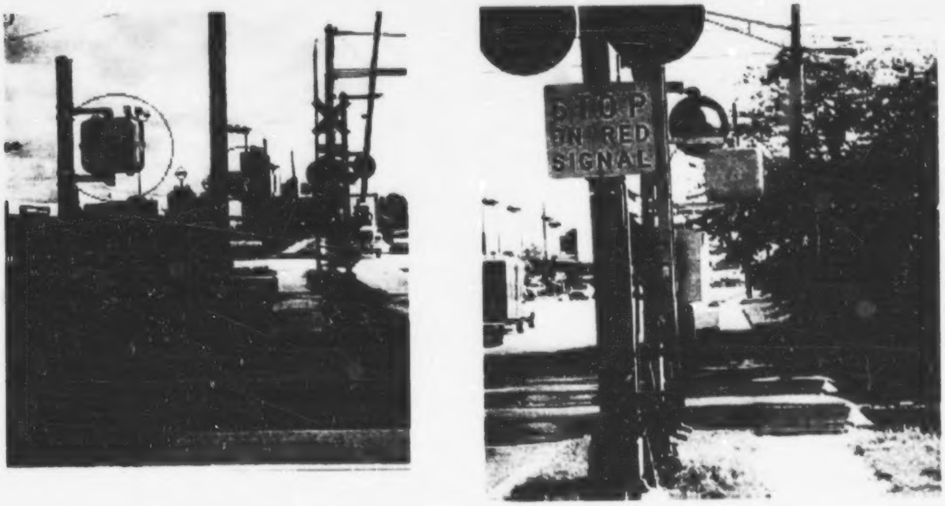
2. Do you feel the new warning system will increase the safety awareness of motorists?
   Response: 91% Yes

3. Is the STC sign positioned in good view of motorists stopped at the crossing?
   Response: 82% Yes

A Web page has been created for access by people using the Internet. Its address is http://www.bcpl.net/~vhartsoc/stcweb.htm. The Web address is listed on the public information flier. The Web page explains the STC project and identifies where it is being tested. It includes photos and animated graphics related to the project.

ADDITIONAL GOAL ACHIEVED (Refer to Figure 5)

An ancillary objective of the project was to provide some form of safety equipment for pedestrians. The MTA has installed four active WALK/DON'T WALK signals to govern pedestrian movements across the tracks. These signals are controlled by the presence of train movements approaching the grade crossing. The pedestrian signals display a steady walking man icon (WALK) at all times except when a train is detected approaching the grade crossing. Within four seconds after detecting a train, the pedestrian signals change from a steady walking man icon to a flashing hand icon (FLASHING DON'T WALK). The flashing hand icon is displayed for a period of 13 seconds, based on a maximum crossing distance of 52 feet. Subsequently, the pedestrian signals change to a steady display of the hand icon (DON'T WALK) until the train has cleared the intersection and the gates are in the full upward position.



PEDESTRIAN SIGNALS - NORTH SIDE PEDESTRIAN SIGNALS - SOUTH SIDE

Figure 5. Pedestrian Signals

PROJECT RESULTS

To measure the effectiveness of the new warning system, video records were captured each time a Second Train Coming (STC) incident took place. The data collection period was ninety days long and took place between August 1998 and November 1998. During the test period, 320 STC incidents were recorded in the 30 day period before the system was activated. In the first 30 days following activation, 363 STC incidents were recorded. In the second 30 days following activation, 348 STC incidents were recorded. Since the MTA has not experienced actual STC-related accidents, the measure of effectiveness was based on "risky behaviours" demonstrated by motorists during STC incidents. The MTA contracted a traffic-engineering consultant, Sabra Wang & Associates, to analyse the video records based on the behaviour of motorists during STC incidents. A comparison of risky behaviours before and after the system was activated was performed. The comparison sought to determine whether the system proved successful in altering the behaviour of motorists during STC incidents.

Two scenarios that can occur during an STC event were identified. In one scenario, the crossing gates come down during the movement of a first train but start to go up just before a second train causes them to start going back down. If drivers started to cross the tracks while the gates were going up following the first train, this was recorded as a risky behaviour. Drivers are supposed to wait until the gates reach their full vertical position and the red crossing lights cease to flash. The tabulation of this behaviour was as follows:

Number of recorded occurrences	
30 days before system activation	53
1st 30 days after system activation	49
2nd 30 days after system activation	39
Percentage change:	decreased by 26%

In the second scenario, the crossing gates remain down following the passage of a first train because an unseen second train is approaching the crossing (in this scenario, the two trains are closer together than in the first scenario). If drivers began to move their vehicle forward while the gates were down, but stopped after noticing that a second train was coming, this was recorded as a risky behaviour. The tabulation of this behaviour was as follows:

Number of recorded occurrences	
30 days before system activation	21
1st 30 days after system activation	10
2nd 30 days after system activation	3
Percentage change:	decreased by 86%

The FTA fully funded this project through a grant of $200,000. The grant covered the cost of the project including:

- Engineering design
- Interface to existing grade crossing circuits
- Video monitoring/recording equipment
- Purchase of two message signs and pedestrian signals
- Installation of equipment
- Analysis of data
- Public survey
- Reporting documentation

PROJECT SCHEDULE

1. Award of grant to the MTA	3/97
2. Engineering design completed	8/97
3. Specification for signs completed	10/97
4. Delivery of signs to the MTA	5/98
5. Installation of signs	8/98
6. Data collection period	8/98 to 11/98
7. Analysis and draft report completed	2/99

PROJECT CONCLUSIONS

Based on analysis of data recorded during STC events, the MTA concludes that the presence of the Second Train Coming Warning Sign reduced risky behaviours as demonstrated by drivers during STC incidents. Furthermore, the public finds the system to be an appropriate safety device for its intended purpose.

FUTURE OF SECOND TRAIN SIGNAGE

The MTA submitted a draft of the final project report to the FTA in February 1999. In November 1999, the FTA returned comments to the MTA. The MTA has hired Sabra Wang & Associates to produce the final project report. Notice to proceed was issued in September 2000 and the delivery of the report is expected in December 2000. The FTA will eventually publish a report on the project that will be available to transit agencies and railroads throughout the country. This may lead to future federal policy encouraging the deployment of such signage at other rail-highway intersections with frequent second train coming incidents.

A Video Sensor for Automated Enforcement and Safety Monitoring of Grade Crossings

Douglas L. Reilly
Nestor Traffic Systems, Inc.
Providence, Rhode Island

ABSTRACT

According to the U.S. National Highway Traffic Safety Administration (NHTSA), a train collides with a vehicle or a person once every 100 minutes and, in an average year, more people die in rail-highway crossings than in commercial airline crashes. The need for increased safety at rail crossings has escalated as a direct result of the growth in vehicle traffic and other factors, such as the introduction of high speed rail service, community pressures to ban train whistle blowing at crossings, and the general increase in aggressive driving behaviour that can result in more frequent crossing violations.

With support from the U.S. Transportation Research Board, Nestor Traffic Systems, Inc. has developed video monitoring technology for real-time detection of rail-highway traffic, train, and signalization events that can be used to assess and, ultimately, reduce grade crossing risk. The outcome of this development effort is a system, called Rail CrossingGuard, that can monitor vehicle and train behaviour at crossings. For active crossings, the system can additionally monitor gates and signal lights to determine whether these devices are functioning properly. Rail CrossingGuard can be used for automated enforcement of vehicle grade crossing violations, for real-time detection of hazardous crossing conditions, and for ongoing or periodic collection of operational data to identify patterns in grade crossing risk. This presentation describes how Rail CrossingGuard addresses grade crossing safety issues through automated enforcement and operational monitoring.

RÉSUMÉ

Selon la National Highway Traffic Safety Administration (NHTSA) des États-Unis, toutes les 100 minutes, un train entre en collision avec un véhicule ou un piéton et au cours d'une année moyenne, il y a plus de gens qui perdent la vie à la suite d'un accident à un passage à niveau que dans des accidents d'avions de lignes commerciales. Le besoin d'accroître la sécurité aux passages à niveau s'est accentué en raison directe de la croissance du débit de véhicules et d'autres facteurs, comme la mise en service de trains rapides, les pressions des collectivités visant le bannissement des sifflets de trains aux passages à niveau et de l'augmentation générale de la fréquence des comportements agressifs chez les conducteurs, pouvant se traduire entre autres par des infractions plus fréquentes aux passages à niveau.

Fort de l'appui du U.S. Transportation Research Board, Nestor Traffic Systems, Inc. a mis au point un dispositif de surveillance vidéo pour la détection en temps réel des véhicules et des trains traversant les passages à niveau, et des incidents touchant la signalisation. Les images vidéo peuvent servir à évaluer et, à terme, atténuer le risque posé par les passages à niveau. L'aboutissement de ces travaux de développement est un système, appelé *Rail CrossingGuard* (gardien de passage à niveau), qui surveille le comportement des véhicules et des trains aux passages à niveau. Dans le cas de passages à niveau automatisés, le système peut aussi surveiller le fonctionnement des barrières et des feux de signalisation. Le *Rail CrossingGuard* peut être utilisé pour l'application automatisée du code de la route en regard des infractions commises par les automobilistes aux passages à niveau, pour détecter en temps réel un danger à un passage à niveau et pour colliger périodiquement ou en continu des données d'exploitation permettant de cerner des tendances en ce qui a trait au risque posé par les passages à niveau. Cette présentation décrit comment le *Rail CrossingGuard* contribue à accroître la sécurité aux passages à niveau par l'application automatisée des règles en cas d'infraction et par la surveillance des dispositifs de signalisation.

Nestor Traffic Systems

One Richmond Square
Providence, RI 02906

Rail CrossingGuard

Video Monitoring for
Grade Crossing ***Safety***

Rail CrossingGuard

- Based on Nestor's object tracking video monitoring technology
  - Extended with support from Transportation Research Board's **IDEA** Program
- Leverages company's existing video monitoring products
  - TrafficVision - video-based traffic monitoring
  - CrossingGuard - video-based red light violation enforcement & intersection safety system

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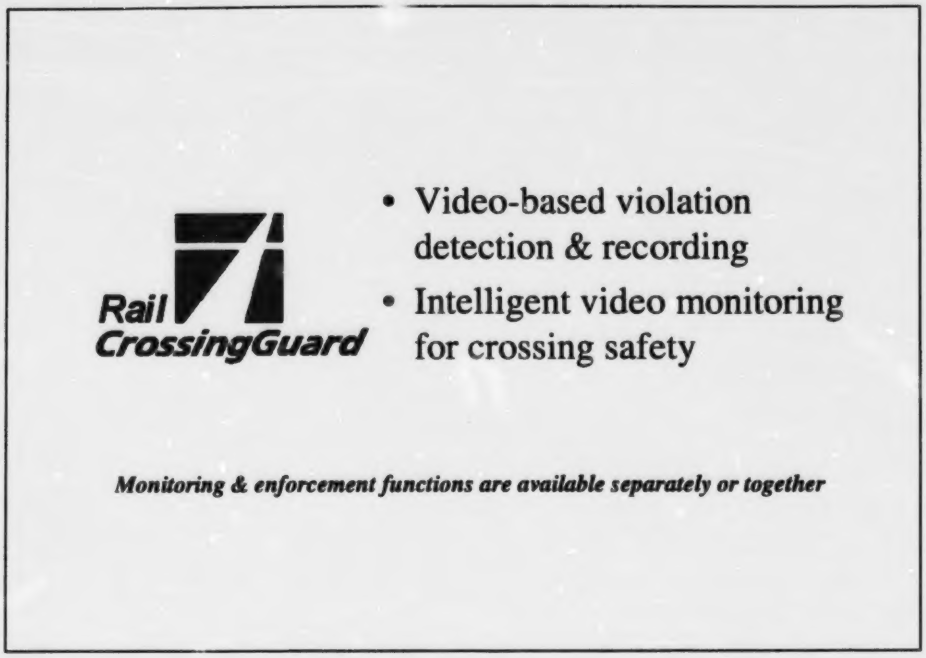
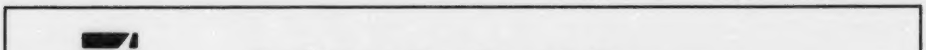


Rail CrossingGuard

- Video-based violation detection & recording
- Intelligent video monitoring for crossing safety

Monitoring & enforcement functions are available separately or together



Rail CrossingGuard Cameras

- "Overview" camera
  - used to detect violators
  - records 3-5 second full-context video
- "Tracking" camera
  - software-controlled to zoom in on violating vehicle
  - records 20/30 close-up clips of front/rear license plate and, optionally, driver image

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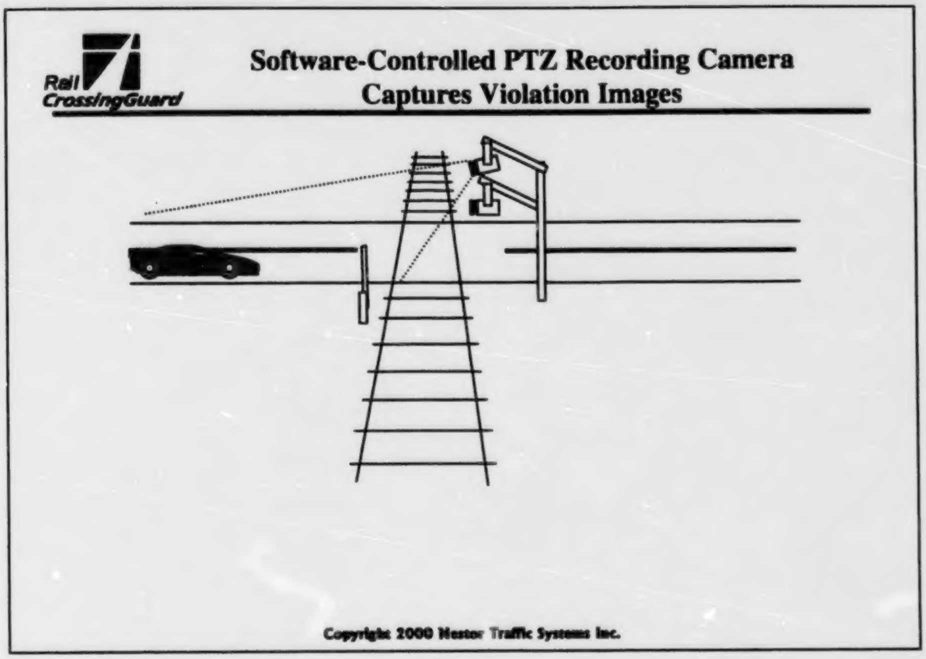

Rail CrossingGuard

Software-Controlled PTZ Recording Camera Captures Violation Images

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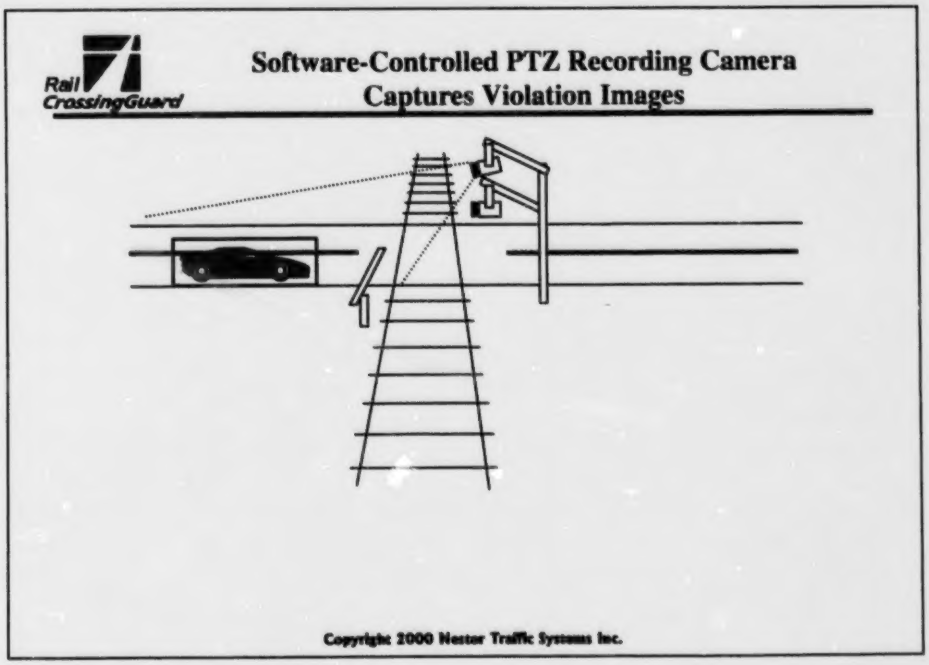

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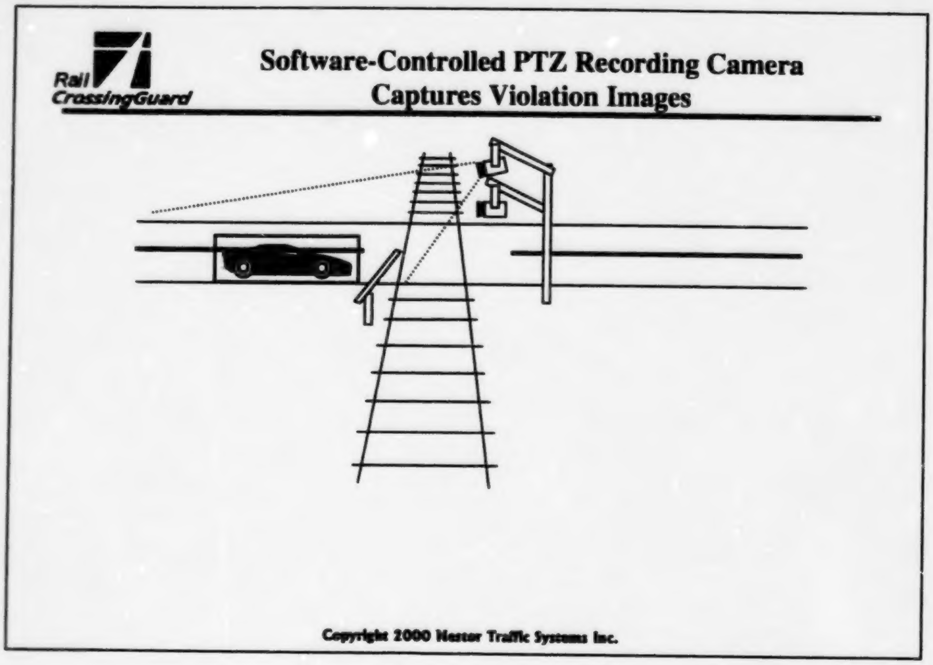

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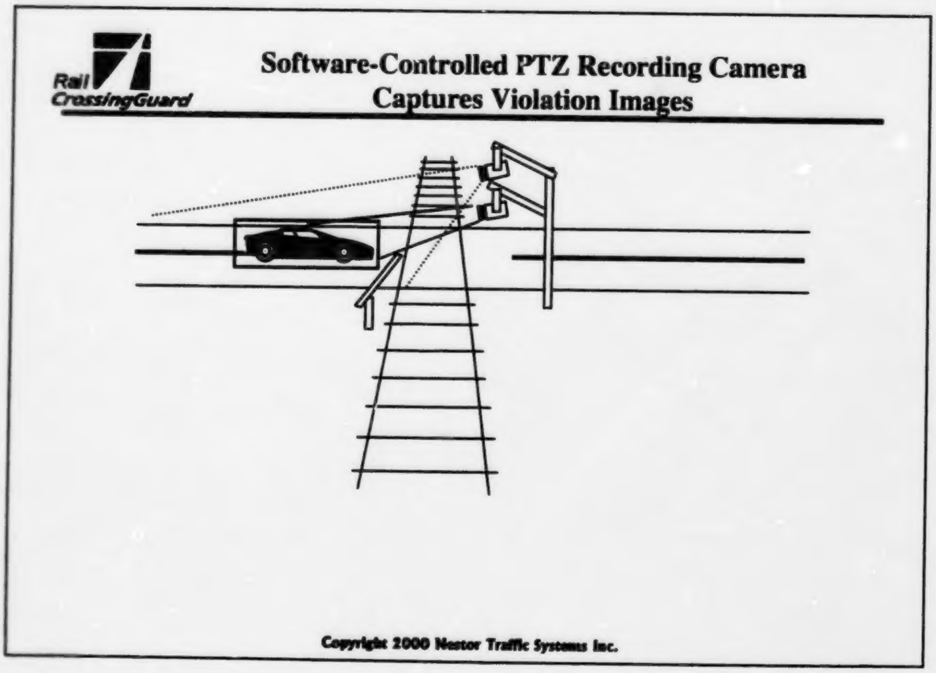

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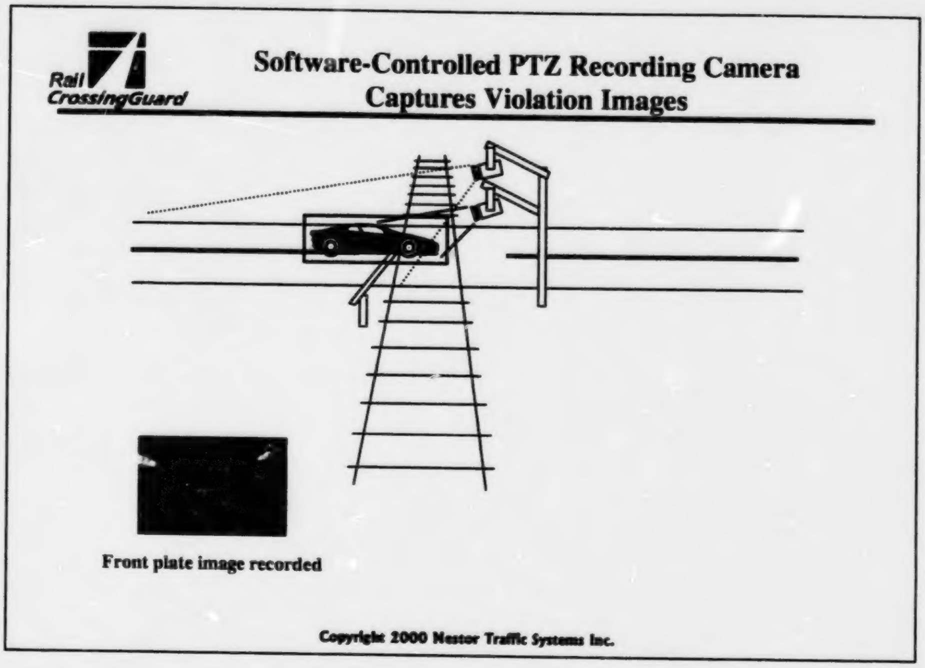

Software-Controlled PTZ Recording Camera Captures Violation Images

Front plate image recorded

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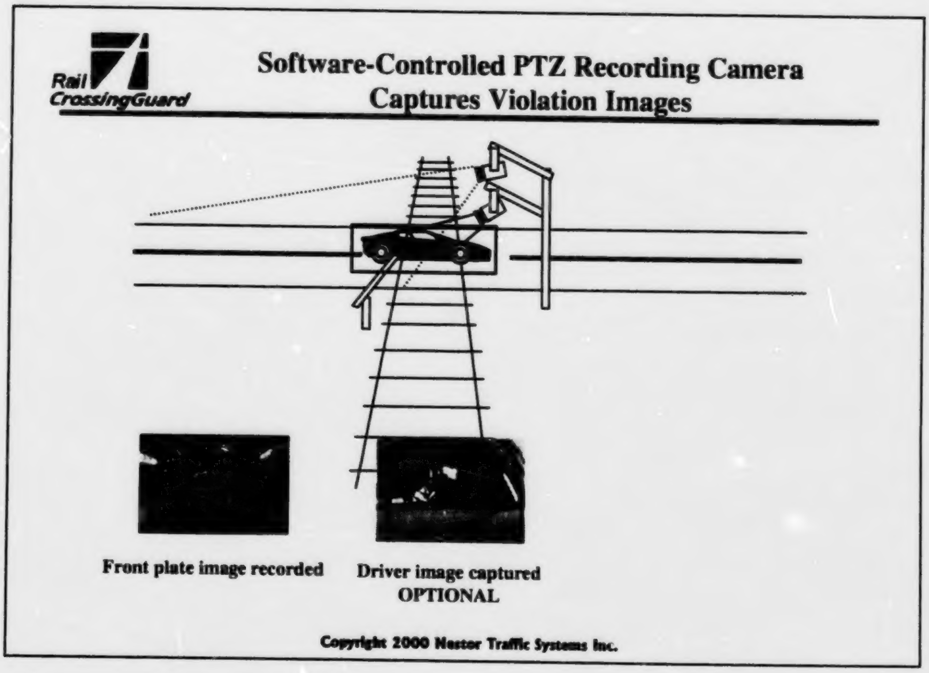

Software-Controlled PTZ Recording Camera Captures Violation Images

Front plate image recorded

Driver image captured
OPTIONAL

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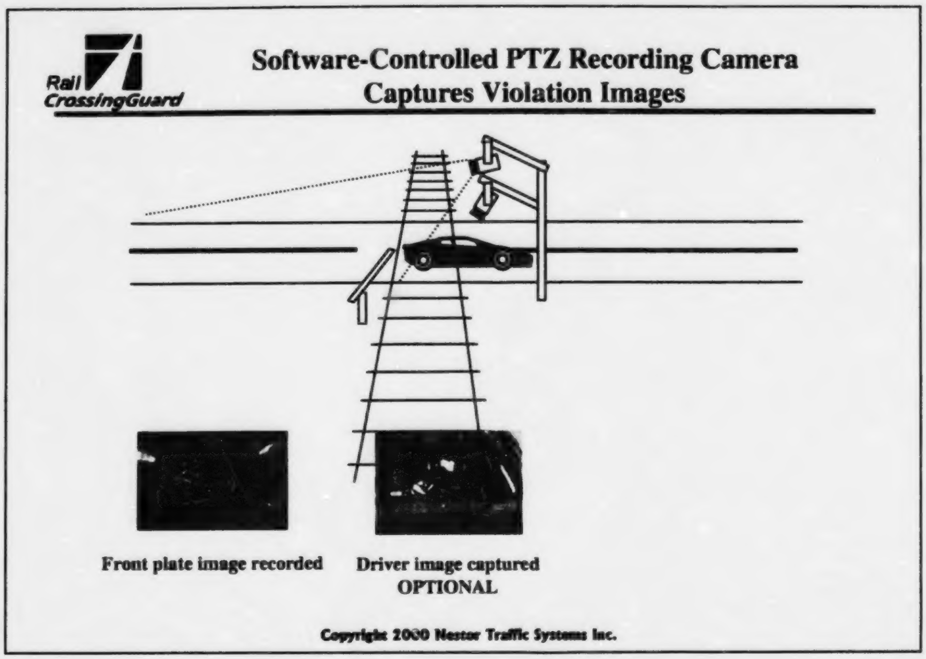

Software-Controlled PTZ Recording Camera Captures Violation Images

Front plate image recorded

Driver image captured
OPTIONAL

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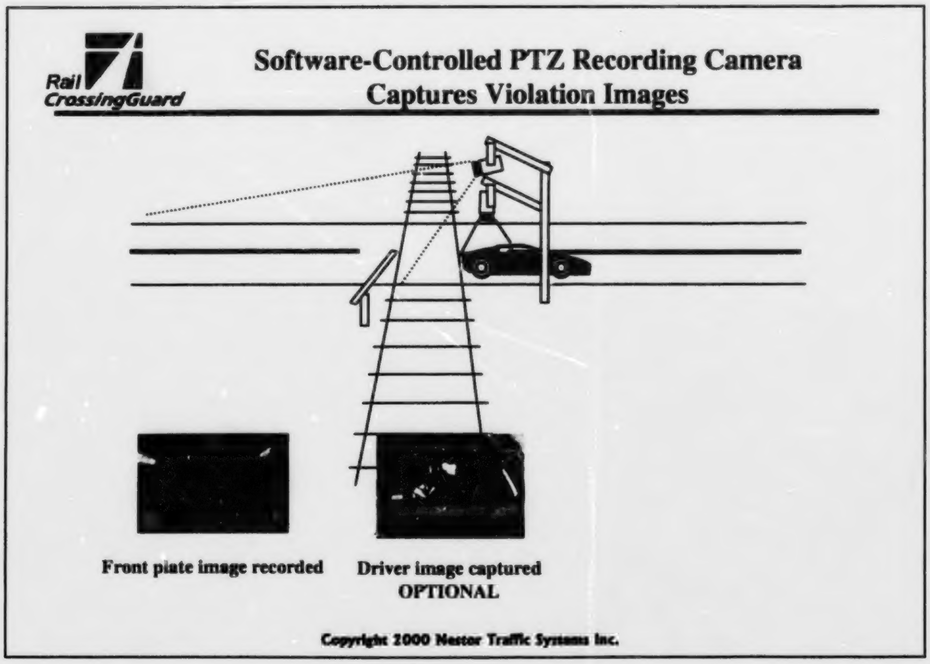

Software-Controlled PTZ Recording Camera Captures Violation Images

Front plate image recorded

Driver image captured
OPTIONAL

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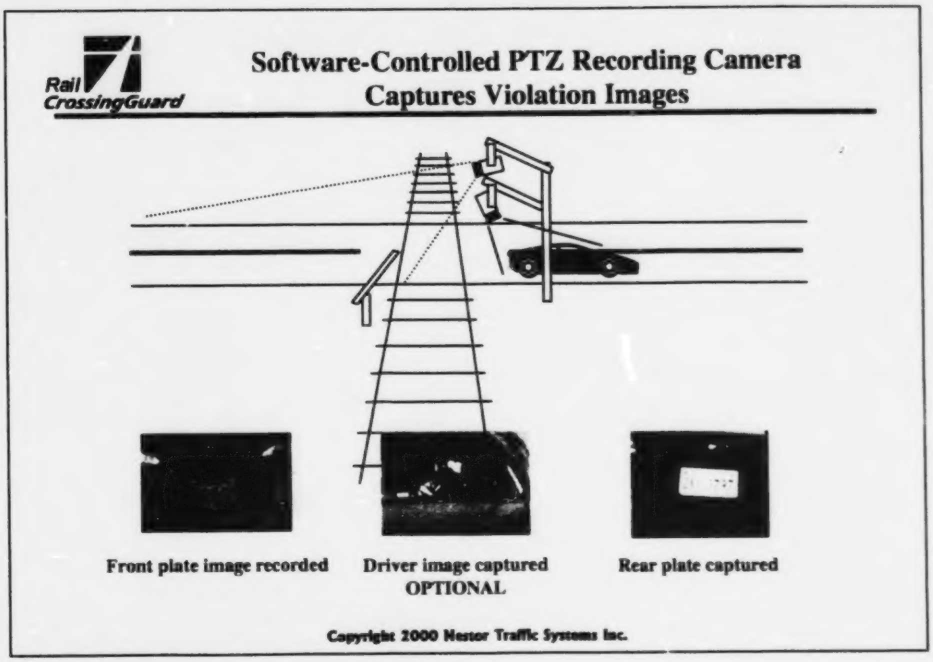

Rail CrossingGuard

Software-Controlled PTZ Recording Camera Captures Violation Images

Front plate image recorded

Driver image captured
OPTIONAL

Rear plate captured

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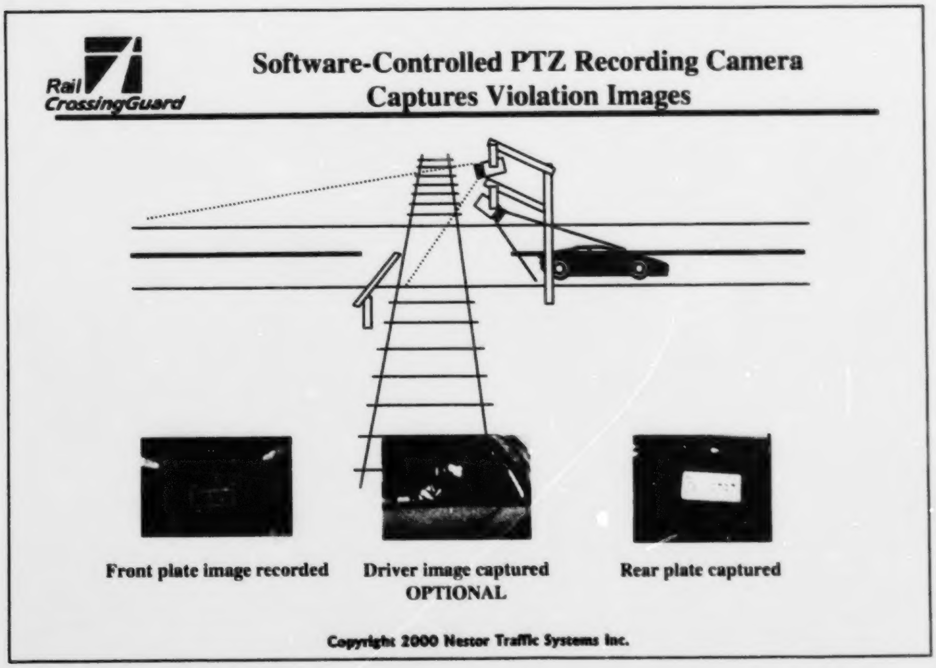

Rail CrossingGuard

Software-Controlled PTZ Recording Camera Captures Violation Images

Front plate image recorded

Driver image captured
OPTIONAL

Rear plate captured

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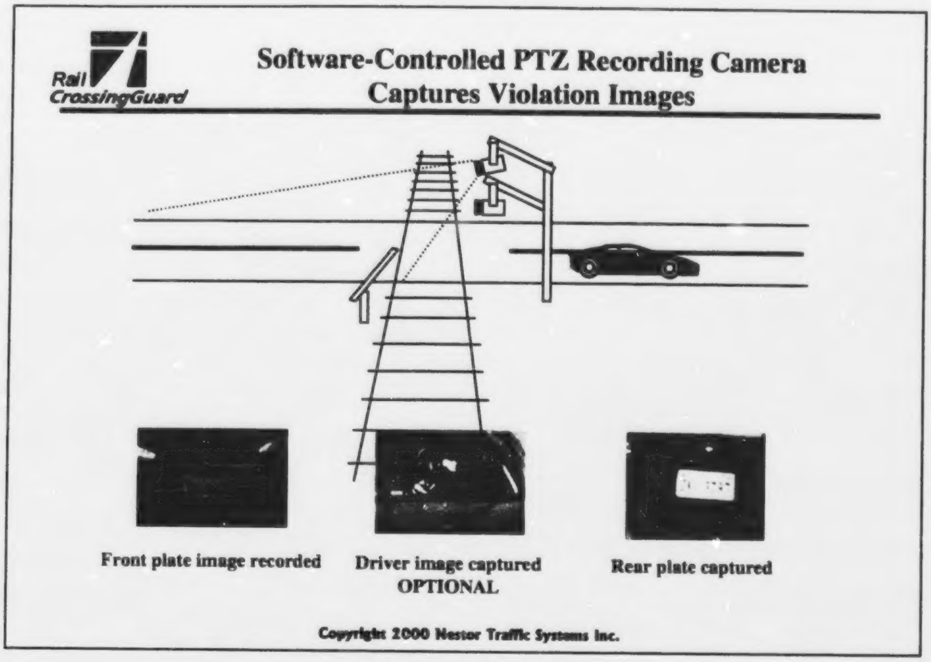

Rail CrossingGuard

Software-Controlled PTZ Recording Camera Captures Violation Images

Front plate image recorded

Driver image captured OPTIONAL

Rear plate captured

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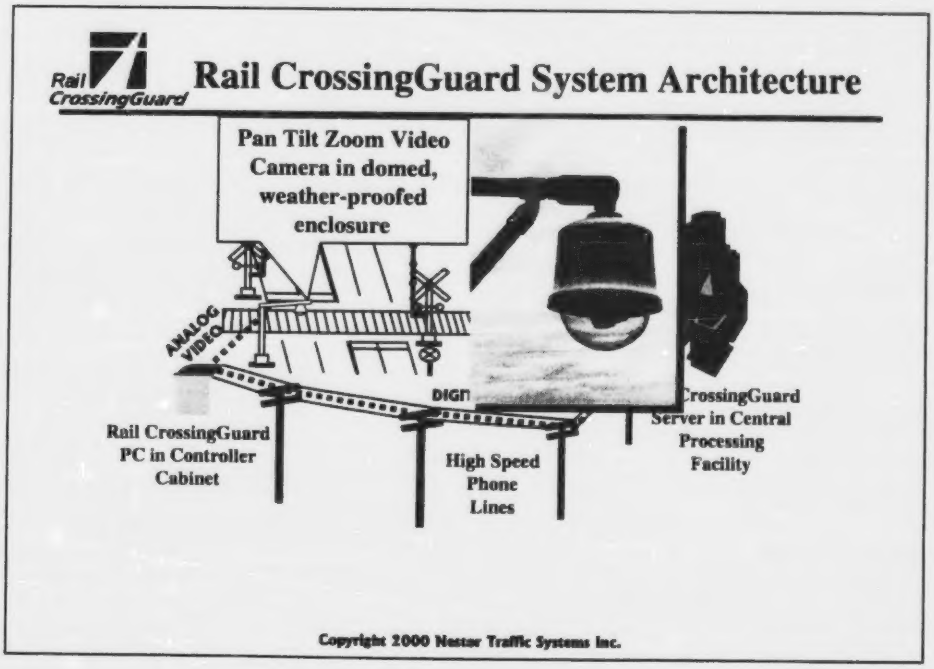

Rail CrossingGuard

Rail CrossingGuard System Architecture

Pan Tilt Zoom Video Camera in domed, weather-proofed enclosure

Rail CrossingGuard PC in Controller Cabinet

High Speed Phone Lines

CrossingGuard Server in Central Processing Facility

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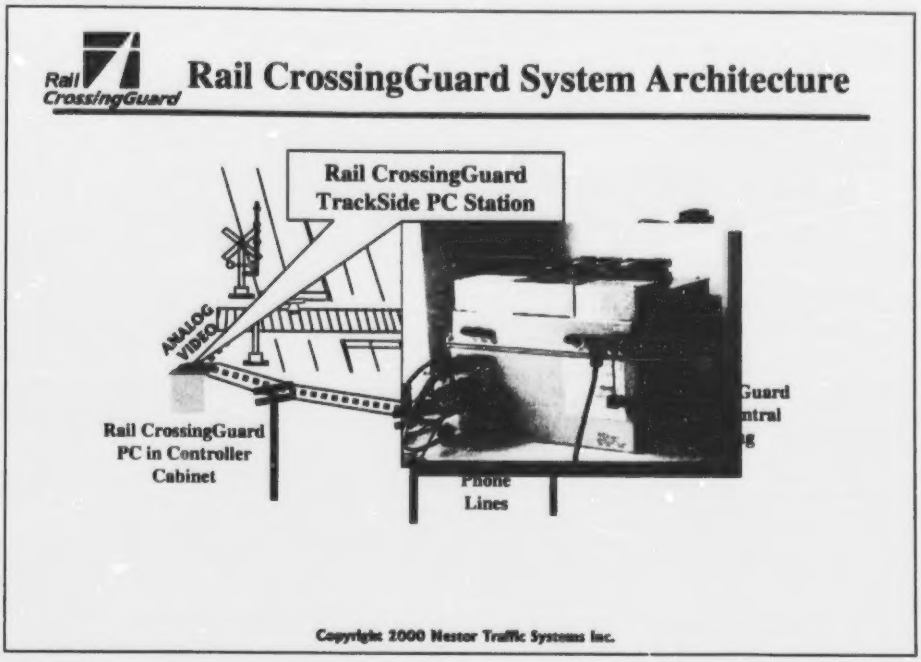

Rail CrossingGuard System Architecture

Rail CrossingGuard TrackSide PC Station

ANALOG VIDEO

Rail CrossingGuard PC in Controller Cabinet

Guard
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Phone Lines

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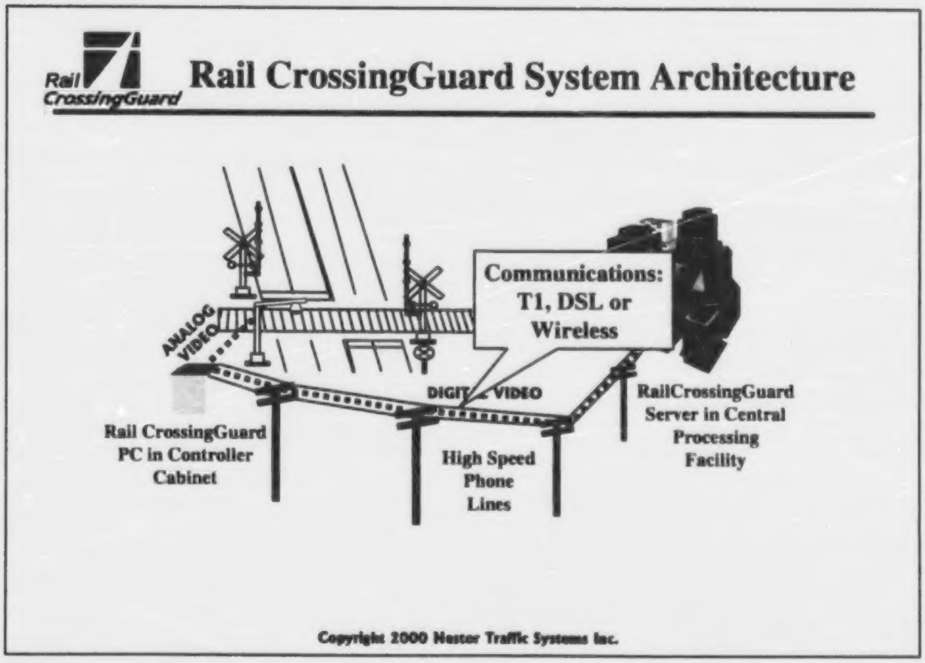

Rail CrossingGuard System Architecture

ANALOG VIDEO

Communications: T1, DSL or Wireless

DIGITAL VIDEO

Rail CrossingGuard PC in Controller Cabinet

High Speed Phone Lines

RailCrossingGuard Server in Central Processing Facility

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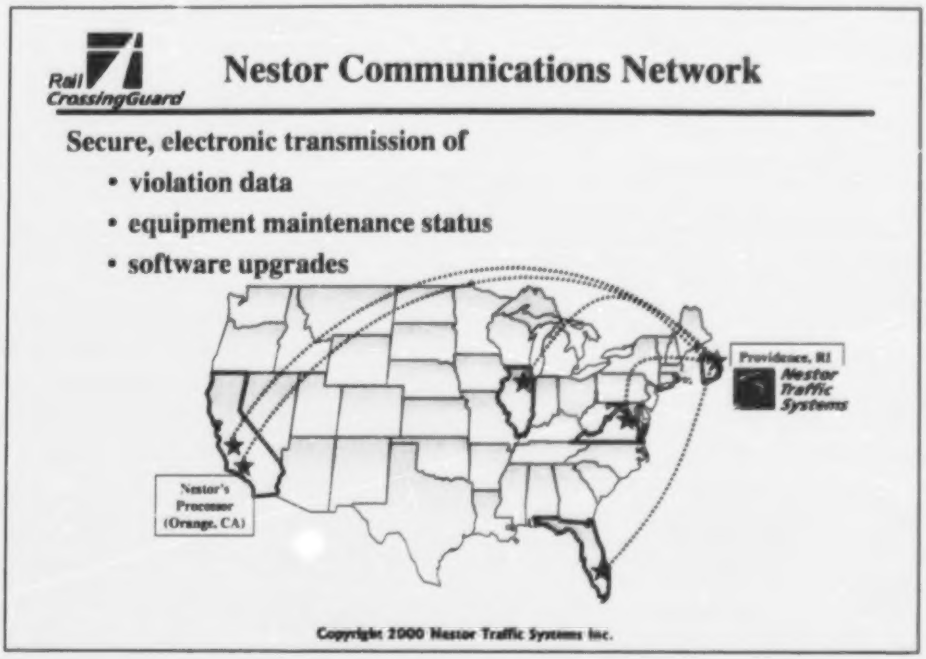

Rail CrossingGuard

Nestor Communications Network

Secure, electronic transmission of

- violation data
- equipment maintenance status
- software upgrades

Providence, RI

Nestor Traffic Systems

Nestor's Processor (Orange, CA)

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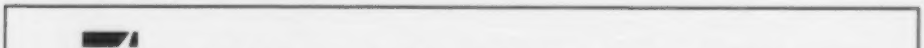

Rail CrossingGuard

Rail CrossingGuard System Architecture

CrossingGuard ServerNT

CitationManager™

RailCrossingGuard Server in Central Processing Facility

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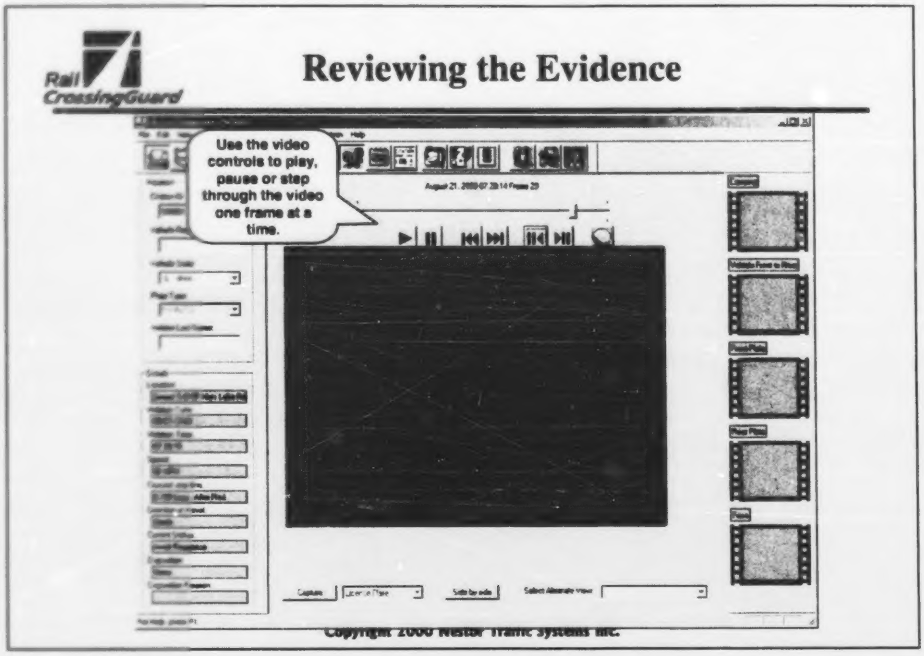

Reviewing the Evidence

Use the video controls to play, pause or step through the video one frame at a time.

Rail CrossingGuard
Help

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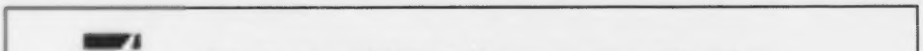

Violation Video Images for Citation

Rail CrossingGuard
5Y4215

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Rail CrossingGuard

Rail CrossingGuard Enforcement

- Video-based evidence produces higher citation rates, reduces court impact
- Faster citation issuance through real-time transmission of digital violation data to central site
- Ease of installation
  - no loops for vehicle presence detection; optional interface to rail signalization
- High speed communications network enables effective maintenance and support
  - remote troubleshooting of hardware, software, and camera functionality directly from NTS Operations Center

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Rail CrossingGuard

Rail CrossingGuard: ITS Safety Features

Intelligent video monitoring for crossing safety

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Rail CrossingGuard ITS Monitoring

- Vehicle presence on tracks
- Train presence on tracks
- Position/presence of crossing arms
- Functional status of signal lights

Outcome of TRB-sponsored research program to improve crossing safety

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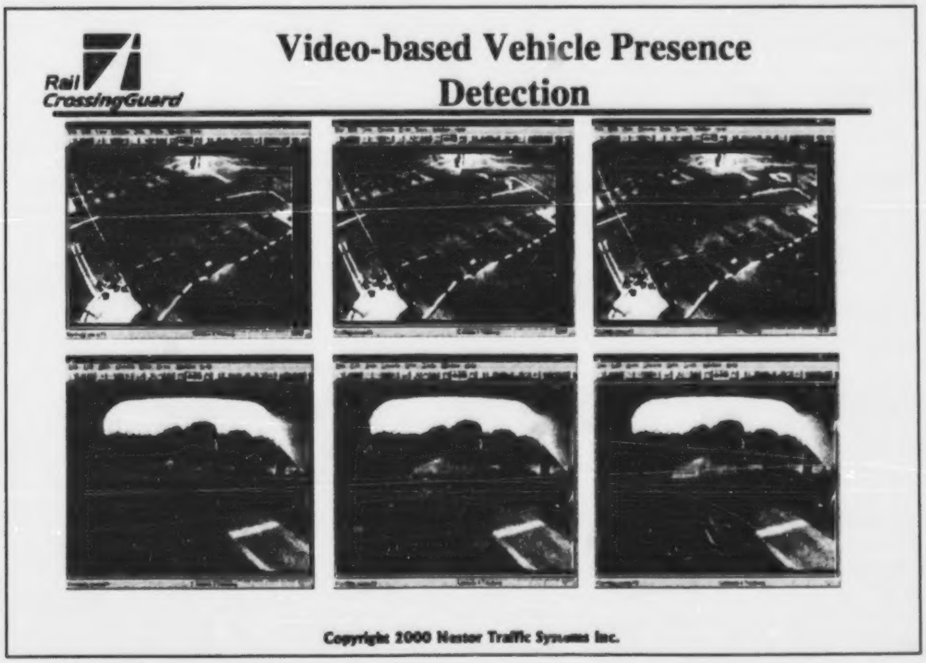

Video-based Vehicle Presence Detection

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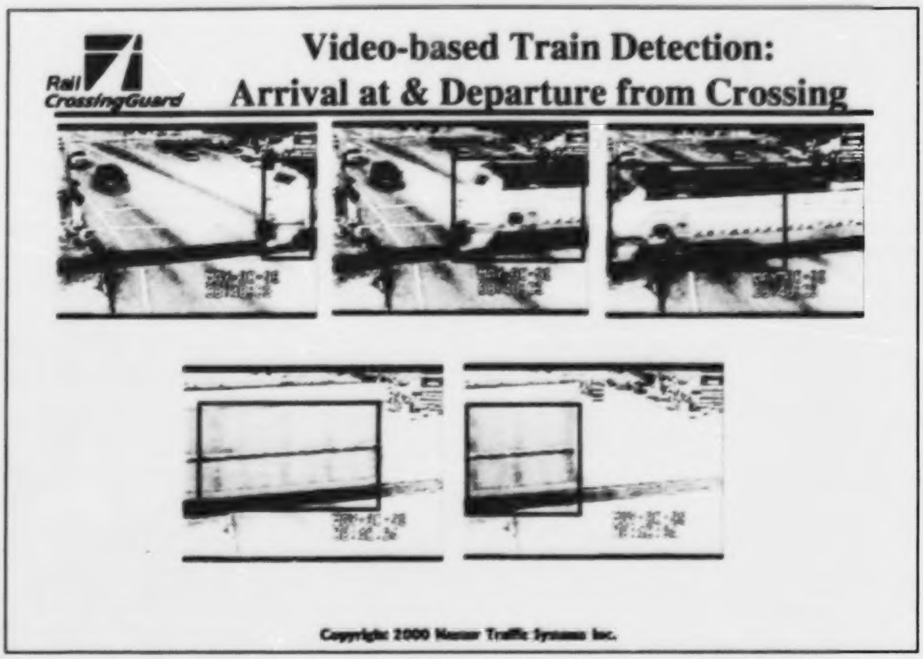
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Video-based Train Detection: Arrival at & Departure from Crossing

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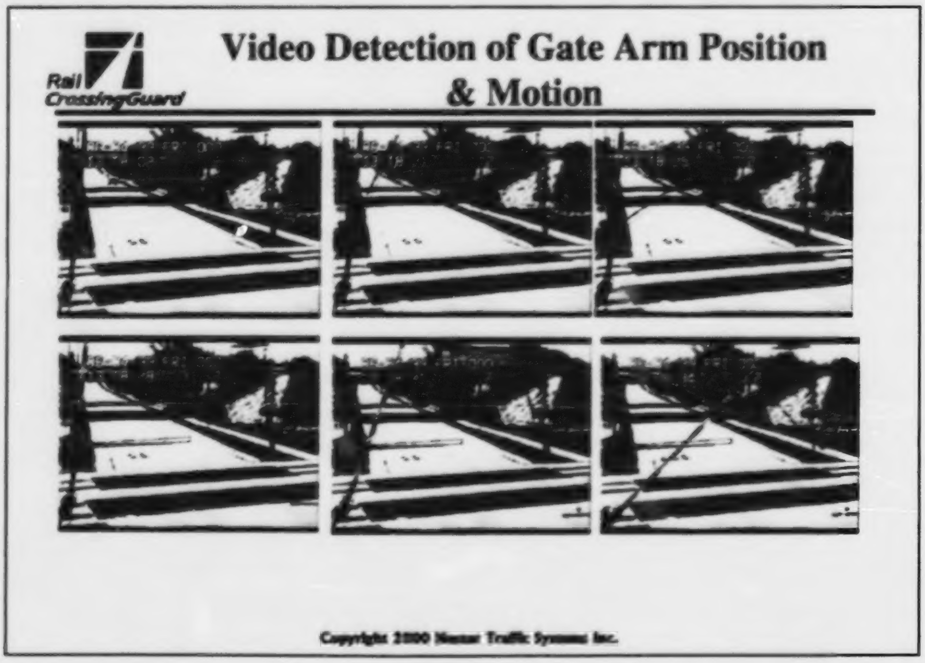
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Video Detection of Gate Arm Position & Motion

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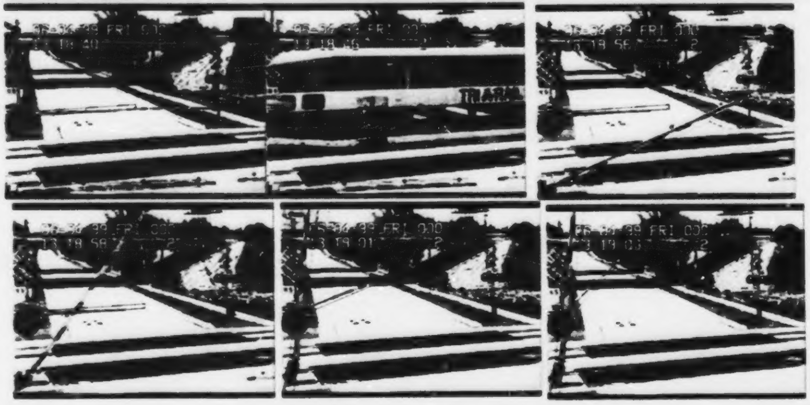
Video Detection of Gate Arm Position & Motion



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Data Logging of Crossing Operation for Analysis

- Stores data logs of vehicle/train behaviours to support improved crossing engineering treatments
  - vehicle counts & speeds; vehicle classification; peak travel time behaviour
  - train speeds
  - signalization operation

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Rail CrossingGuard

Optional Provision of Additional Violation-Related Information

- Violations that occur in the context of gate malfunctions
  - false gate activations
  - improper gate timing
- Vehicles stopped on tracks even when signals are not active

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Rail CrossingGuard

Real-Time Monitoring & Alerts of Hazardous Crossing Conditions

- Vehicle presence on tracks
- Signal status operation
  - false gate activations
  - improper gate timing
  - broken gate arms
  - light failure
- Train operation
  - stopped trains at crossing
  - train speeds through crossing

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Real-Time Information Where It's Needed

- Real-time crossing status information to
  - Rail Operations Center
  - DOT
  - Police/Emergency Services
  - Train*

**** Nestor is partnering with GeoFocus, Inc. to introduce AWARE, Advanced Warning and Alerts for Railroad Engineers***

- Send crossing status warnings directly to approaching locomotive

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Rail CrossingGuard Installations in 2000

- DuPage County, IL
  - Enforcement system at Sunset Ave. crossing in Winfield Twp.
- Florida DOT
  - Monitoring system at 5 crossings in Ft. Lauderdale area
    - 1 crossing will feature enforcement

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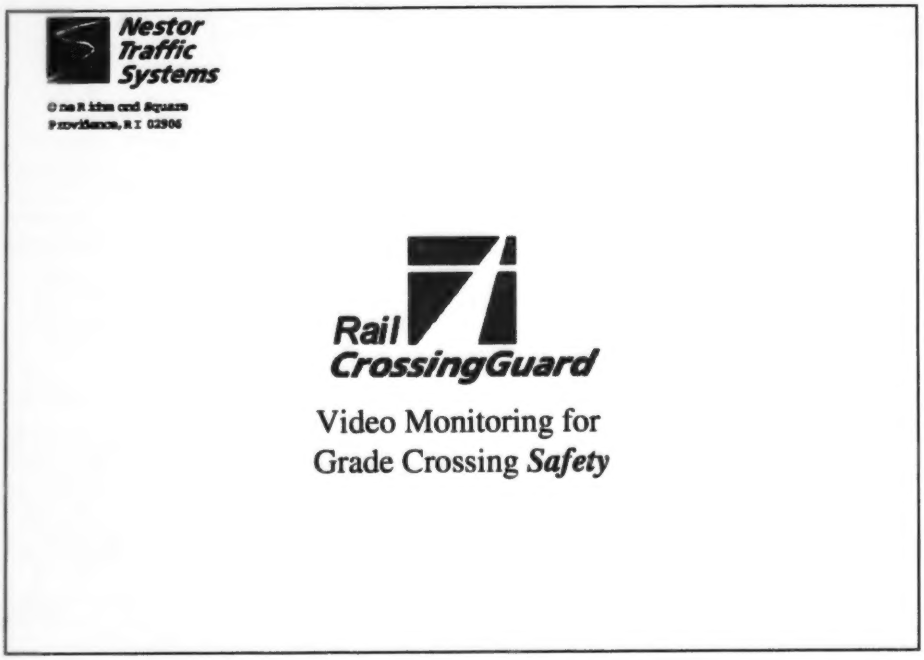


Nestor Traffic Systems

One Richmond Square
Providence, RI 02906

Rail CrossingGuard

Video Monitoring for
Grade Crossing *Safety*

Wheel Counters for North American Signalling Systems

Adam M. Street
Foster Technologies Inc.
Burlington, Ontario

SUMMARY

Wheel counters have been around for over 40 years. They are used primarily in Europe as replacements for track circuits in a variety of different applications, such as rail-road crossings and fixed block signalling, and for areas with special requirements where traditional systems fail to function reliably. These can include sections of track that have poor shunts as a result of ballast conditions or that use lightweight aluminum trains. These can prevent track circuits from functioning correctly, leading to unreliable and unsafe operations.

L.B. Foster Company bought Southdale Integrated Systems in 1998 with a view to introducing this technology into the North American market. The first step is the introduction of the wheel-counter technology into non-vital areas of the market, such as yard switch point protection. The primary aim is to employ vital wheel counters as a more cost-effective and safer alternative to track circuits in applications such as rail-road crossing control and traffic pre-emption.

SOMMAIRE

Les compteurs d'essieux existent depuis plus de 40 ans. On les trouve surtout en Europe, où ils remplacent les circuits de voie dans différentes applications, comme aux passages à niveau et pour les signaux de cantons fixes, ainsi que sur des tronçons de voie particuliers, où les systèmes classiques ne sont pas toujours fiables. Il peut s'agir, par exemple, de tronçons de voie où la détection du shunt d'un train se fait mal en raison de l'état du ballast ou du fait qu'il s'agit d'un train léger en aluminium. Les circuits de voie risquent alors de mal fonctionner et d'engendrer des conditions d'exploitation dangereuses.

En 1998, L.B. Foster Company achetait Southdale Integrated Systems en vue de lancer la technologie mise au point par cette entreprise sur le marché nord-américain. La première étape a consisté à utiliser des compteurs d'essieux pour des applications non cruciales pour la sécurité, comme la protection d'aiguilles de triage. L'objectif, à terme, est d'utiliser les compteurs d'essieux comme substituts plus économiques et plus sûrs aux circuits de voie, dans des applications comme le contrôle des trains aux passages à niveau et le contrôle des droits de passage.

ABBREVIATIONS

OBB	Austrian Railways
SBB	Switzerland (rail administration)
DBAG	Germany (rail administration)
CFL	Luxembourg (rail administration)
NSB	Norway (rail administration)
BV	Sweden (rail administration)
NMBS / SNCB	Belgian Railways
SNCF	French Railways
RENFE	Spanish Railways
FS	Italian Railways
SSI	Solid Sate Interlocking
BR	British Railways (now Railtrack)
AZL90, AZS70	Axle Counters (Alcatel models)
VIOS	Vital Input Output System
VAP	Vital Application Processor

INTRODUCTION

Although wheel counters have a similar function to track circuits for signalling systems, their use is not so widespread, especially in North America. This paper and presentation sets out the following: the use of wheel counters in Europe; the Foster Technologies product in a rail-road crossing system application; and a detailed technical description of the Foster Technologies product.

SURVEY OF THE EUROPEAN SITUATION

Looking at the current European situation, four groups of countries can be distinguished, reflecting the varying degrees of use of wheel counters in their national railways.

The first category are the railway administrations that have a tradition in the application of wheel counters: OBB, SBB, DBAG, and CFL.

In the second category are those countries where wheel counters are considered as a fringe activity, such as RENFE, SNCF, BR, and FS. Here, they are considered as an alternative to track circuits and are used where cost or local conditions render the use of track circuits inappropriate. For a long multiple track circuited section of line, wheel counters offer a cheaper and safer alternative solution if the line is lightly used and carries lightweight vehicles. Where the rails are bolted directly to bridge grinders, leading to zero ballast resistance, wheel counters have been used. They are also applied in areas prone to surface water such as in tunnels and where lines cross at right angles at grade.

The third category doesn't use wheel counters at all: NSB and BV.

The fourth and last category is new in the business. NSB is experimenting with wheel counters on lines only used by light diesel trainsets. NMBS/SNCB have already commissioned some wheel counters on single track lines, in conjunction with a block system, and are now introducing wheel counters in freight stations and sidings. Here wheel counters offer a higher degree of safety and, because they are rust resistant, they are more economical. Indeed, in the points, the rods do not need an insulation as is the case when track circuits are applied.

A supplementary problem arises when wheel counters are installed at the head of a set of sorting sidings. The counter, which controls the detectors, has to know the correct position of the points. For example, a close link with the interlocking equipment is a prerequisite. NMBS/SNCB solved this problem in a practical way. In stations with an electronic interlocking, the SSI computers are used to control the detectors, whilst in an all-relay installation a set of two, mutually coupled, industrial microcomputers read the relay contacts of the interlocking and record the wheels present in the head of the set sorting sidings. Their outputs are then fed back into the relay interlocking.

Since not all tracks can be insulated sufficiently to permit the use of track circuits, the wheel counter was developed for train detection independent of track condition. The philosophy is based on the assumption that a section is clear when the number of wheels that left a defined track section equals (not more and not less) the number of wheels that previously entered this section, provided the section was clear initially.

Results of earlier tests provided encouragement to proceed with development after 1945. The task was to design a sensor, or wheel detector, able to distinguish individual wheels, passing at any permissible speed, from any other object in the vicinity, and to detect the wheel's direction of travel. Another device had to be designed, which, in collaboration with the wheel detectors, was fast enough and had sufficient storage capacity for any number of wheels detected. This is known as a counter. To complicate the task, counting in and out can take place simultaneously and occasional miscounting has to be provided for, both technically and operationally. The distance between wheel detectors and counter should be as great as possible. Although axle counters are also used in stations, the main area of application is for open lines, as an integral part of automatic block systems.

With the technological means available at the time, the first wheel counter system was approved and accepted for commercial service in 1955. It consisted of wheel detectors with biased, magnetically operated contacts and electromechanical rotary selector counters, later motor counters, linked by signal cables. Output to the interlocking was via contact combinations of two relays never in concordance. In spite of many improvements, the magnetically operated contacts proved to be the limiting factor.

Higher speeds, longer trains, smaller wheels closer together, magnetic rail brakes, higher traction return currents, stray magnetic fields, and flangeless wheels could all only be handled by radically different wheel detectors and counters with increased capacity. New technology such as fail-safe discrete electronics resulted in new generations of wheel counter systems, represented by AZL90 and AZS70. Both systems use electronic wheel detectors on the rail, in which the coupling factor between the transmitting and receiving resonance circuit is affected by the passing of a wheel.

The resulting change is transmitted to the counter, where it is electronically evaluated. Wheel detectors may be mounted in a staggered way on different rails or in pairs on one rail. A minimal distance is required between the sensors to derive the direction of travel. Electronic wheel sensors can be connected to only one counter, or can control both counters of adjacent track sections. The output interface remains as a contact combination of two antivalent relays. With the aid of an electronic converter, electronic wheel sensors can also be combined with a conventional motor counter.

Counters evaluate each complete overlapping pulse pair as a passing wheel. However, even an incomplete pulse pair, for example a wheel not fully passing the detector, results in one of the output relays dropping without the other one picking. This is interpreted as a fault.

A new generation based on vital microcomputers is presently being introduced. In the future, DBAG plan the use of multiple wheel counters with failure redundancy. They will offer a better cost efficiency and a very high reliability. Railtrack installed the AZL90 at Euston for the West Coast Main Line Modernization project.

The latest trend in wheel counters technology is to immunize them against the influences of electromagnetic and eddy current brakes.

FOSTER TECHNOLOGIES (FT) WHEEL COUNTER

The Foster Technologies (FT) product has been designed to overcome weaknesses in European designs for applications in North American signalling systems.

All the current vital wheel counters are European, the major players being the following: Alcatel (the most popular), Siemens, and Harmon Scilliani. They are not currently cost-effective in North America. A multiple check in/check out system utilizing 16 sensor heads (15 block systems) from Alcatel costs approximately U.S. $80,000. The Harmon Scilliani check in/check out system is U.S. $15,000.

The current design improves on maintenance and renewal activities in both the signalling and track disciplines. For example, the Alcatel system prevents the track grinding machines and tampers from operating due to the configuration and location of the sensor heads. In Canada, snowploughs could damage all of the European designs, including the Tiefenbach product.

With this in mind, the principal objectives of the FT design were the following:

- Low-cost design
- Low costs across the lifecycle, with regard to installation, communicating operation, maintenance, and decommissioning, not just for signalling operations, but also for trade activities such as re-railing
- A key component that could be used in a variety of different applications

The system configuration diagram in the presentation outlines how the products fit together. From the four key building blocks (wheel counter and amplifier, VIOS, VAP, and communicator) the following systems can be created: switch point protection; check in/check out systems (track circuit block signalling replacement); pole line elimination; and rail-road crossing control systems.

THE FT WHEEL SENSOR – TECHNICAL DESCRIPTION

The Foster Technologies Wheel Sensor (transducer) is an active inductive proximity detection system with zero speed detection capability. The first system was approved by CN for vital operation in 1998. Since the first installation of the trial traffic pre-emption system, the design of both the hardware and software has been significantly altered for a variety of reasons:

- Changing the magnetic detection principles to remove the risk of detecting track spikes on rail that undergoes significant lateral movement
- Splitting the product into a number of different discrete subsystems to separate system functionality from safety
- Significantly increasing the flexibility of the wheel-counter system for use in a variety of different applications
- Simplifying the hardware and software to make it easier to design products that meet IEEE standards and allow for independent certification

Our patent pending orthogonal sensor design is composed of three inductive coils. The web sensor is ideally positioned vertically in the centre of the unit to measure the distance to the web for off-rail detection. The second and third U-shaped ferrite coils are positioned at the ends of the sensor head to detect the wheel flanges. The coils are driven at different frequencies and are each connected to a driver board that houses the active electronics in a junction box away from the running rails.

The wheel-sensing element is in a resonant tank circuit. It is driven by an excitation current at its resonant frequency. An excitation of approximately 80 and 92 kHz is used to drive the two sensors. This provides an amplitude-modulated sine wave output that varies as the wheel flange traverses the proximity of the sensor. The sensing range of these coils is 50 mm, which allows for differing rail and wheel wear, eliminating the need for vertical adjustments of the sensor head.

The web-sensing element operates at 70 kHz and provides an output dependent on the distance to the web of the rail. This provides off-rail detection and will cause the system to fail-safe whenever the sensor moves away from the track.

Each coil on the sensor has its own distinct resonance frequency that varies with time and temperature. The changes in the sensor characteristics are tracked by incorporating a closed-loop system using internal feedback that compensates for sensor variations.

The output voltage varies according to the distance to the flange and produces a voltage change when a wheel passes over the sensor. The levels are digitized and processed by a high speed microprocessor and are corrected for drift and gain errors. The resultant data is then compared to a threshold comparator and duration discriminator that ascertains whether the pulse is a valid wheel event.

The wheel parameters measured are: wheel counts; speed; direction of travel; and flange height.

Wheel counts are calculated at three times the actual number of wheels seen by the sensors, as each sensor requires a three-phase detection process to register the wheel count. Smaller wheels (such as those used on high-rail vehicles) register a smaller overlap and the unit can be programmed to ignore these types of vehicles. With this three-phase approach, counts are accurate regardless of where a wheel stops and reverses on the sensors.

Since the sensor is not electrically connected to the rail, it does not require insulated joints, bonded rail, or connections or changes in existing track circuits. It operates as a transparent overlay on existing track circuits with no interaction.

The coils' resonant frequencies are different from standard traction return current employed by overhead catenery and third rail traction power, although no physical tests have been undertaken. EMCs generated by AC and DC traction motors have no effect on the sensors.

The sensor has only minute magnetic fields and does not attract metallic debris to its surface. Any iron oxides and rust trapped on the sensor and held by grease and oil will be calibrated out of the magnetic circuit. Even if the sensor has metal debris covering one half of its surface, it will continue to function properly. Beyond that point, the sensor will detect a fouling condition and shut itself down in fail-safe mode. If an object on the sensor (and calibrated into the system) is suddenly removed, the sensor will recalibrate to return the sensor to its baseline immediately.

If a wheel parks directly on the sensor, it will be initially detected. After 30 seconds, the system will recalibrate itself and the wheel into the new magnetic circuit. When the wheel eventually leaves, recalibration is carried out within 100 ms. The system has been designed such that the sensor is calibrated the very moment that the wheel leaves and it is back into service, even if it has been occupied for weeks.

RAILROAD CROSSING ACTIVATION AND TRAFFIC PRE-EMPTION

The control of the crossing gates or traffic pre-emption system is masterminded by the VAP. The VIOS activates the relays that are tied into the sensory control system. The following is a brief description of how the system works.

The VAP polls the amplifier every 0.25 seconds requesting train data using the frequency-hopping freewave radios. If there is no response after 2 seconds, the VAP will fail-safe and instruct the VIOS to close the gates and start the pre-emption.

If the VAP polls the amplifier and receives data regarding a train movement, it will analyse the information and determine when to start operating the various crossing relays. The VAP sends two commands to the VIOS to operate the gates, using different variables and diverse codes. The VIOS compares the two representatives and if they are the same, it knows that the command is valid and will carry it out. As with the polling of the amplifiers by the VAP, if the VIOS does not receive any data from the VAP after two seconds, it will also fail-safe.

CONCLUSION

Wheel counters offer a flexible and cost-effective train detection system that can be used in a variety of different signalling applications. The FT design aims to offer the North American market a product that meets the needs of the railroads in both cost-effectiveness and design.

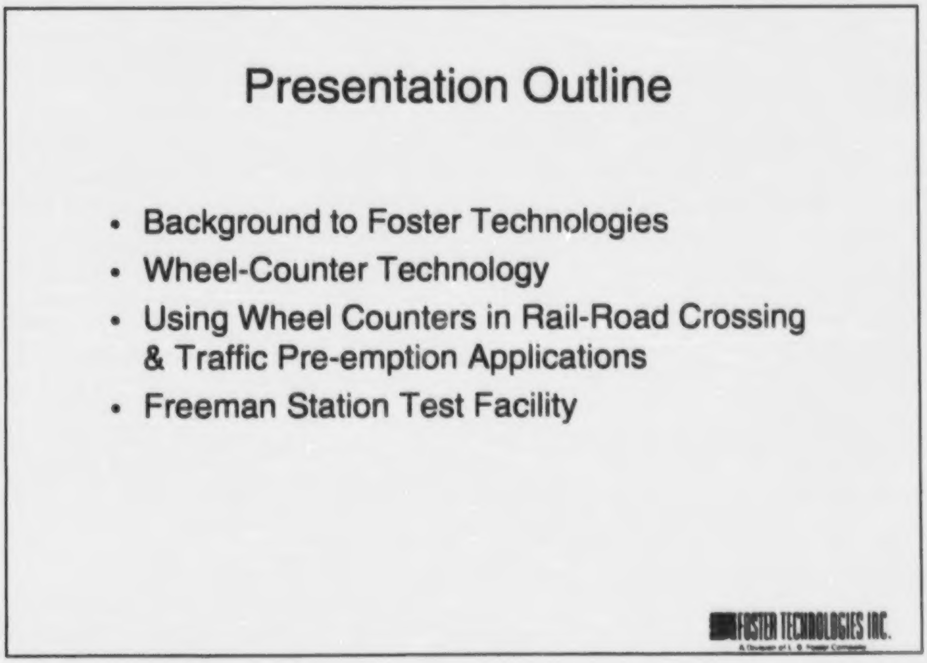
For further information, please visit out website at www.fostertechnologies.com or contact Adam Street at (905) 332-0660.

Applying Wheel-Counter Technology to Rail-Road Crossing Applications

Adam Street
Burlington, Ontario

FOSTER TECHNOLOGIES INC.
A Division of L. B. Foster Company

17/01/01



Presentation Outline

- Background to Foster Technologies
- Wheel-Counter Technology
- Using Wheel Counters in Rail-Road Crossing & Traffic Pre-emption Applications
- Freeman Station Test Facility

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Foster Technologies

- Purchased in 1998 by L.B. Foster
- Traffic Pre-emption system – 1998 (CN)
- HD link system – 1998 (Rail America)
- Development of core products 1998-2000

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Wheel Counters – Brief History

- Magnetic device invented in Europe in 1955
- Counts axles, determines speed and direction,
- Over 40,000 in use in a variety of signalling applications – crossing control, fixed block, and interlockings
- Mainly used in NA for non-vital applications – yards, AEI sites, hot box detectors
- Prototype vital system installed on CN at Terrace, BC, in 1998

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Benefits of Wheel-Counter Technology

- The wheel counter is unaffected by rusty rails, ballast parameters (for areas with wet spots, tunnels, bridges, heavy leaf fall, etc.), and lightweight trains
  - Compatible with all types of existing traction, power and signalling systems throughout their lifecycles
  - Simple to install, commission, operate, and maintain
  - Cost-effective and reliable

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Detection Principles and Vitality

- Drop in voltage from each magnetic coil determines wheel presence – no permanent magnets
- 3-phase wheel detection process to ensure no miscounts for very slow speed and stopped trains
- On-board monitoring of key systems – coil, inductance, and quality factor
- Loosening and off-rail detection to ensure no wheels are miscounted
- Fail safe

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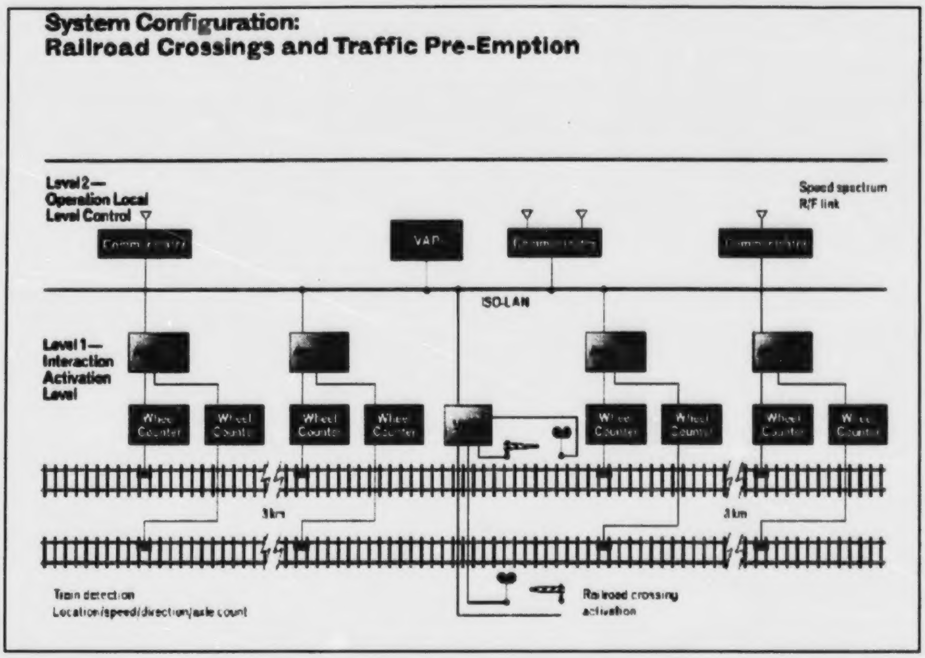
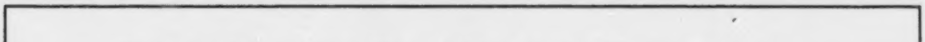


System Configuration:
Railroad Crossings and Traffic Pre-Emption

Level 2—
Operation Local
Level Control
Speed spectrum
R/F link
Communicator
VAP
Communicator
Communicator
ISO-LAN
Level 1—
Interaction
Activation
Level
Wheel Counter
Wheel Counter
Wheel Counter
Wheel Counter
Wheel Counter
Wheel Counter
Wheel Counter
Wheel Counter
3 km
3 km
Train detection
Location/speed/direction/axle count
Railroad crossing
activation



Benefits for Rail-Road Crossings

- Constant warning time, even if higher speed trains are introduced
- Compatible with quadrant gates and island presence detection
- Additional yellow warning light can be added prior to flashing lights or for an oncoming second train
- Monitoring of crossing via the Internet
- High rail vehicles can be ignored if required
- Future Proof

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Rail-Road Crossing Application

- Use wheel counters for approaches and the island
- Outlying wheel counters communicate by frequency hopping radio
- VAP constantly polls wheel counters for information
- VAP instructs VIOS to activate the railroad crossing relays when appropriate.

FOSTER TECHNOLOGIES INC.

Safety Principles

- Wheel-counter system safety is achieved by the following processes:
    - Splitting product systems into discrete subsystems and ensuring that the probability of wrong side failure meets or exceeds industry standards (RT)
    - Undertaking real-time, ongoing self-testing of all components, ensuring integrity of data and subsystems on the safety critical path
    - Using the process of parallel-path processing to compare critical data
    - Verifying software/hardware (IEEE/CENELEC)
- High quality components with proven track records
- Detailed understanding of lifecycle risks from all interfacing disciplines

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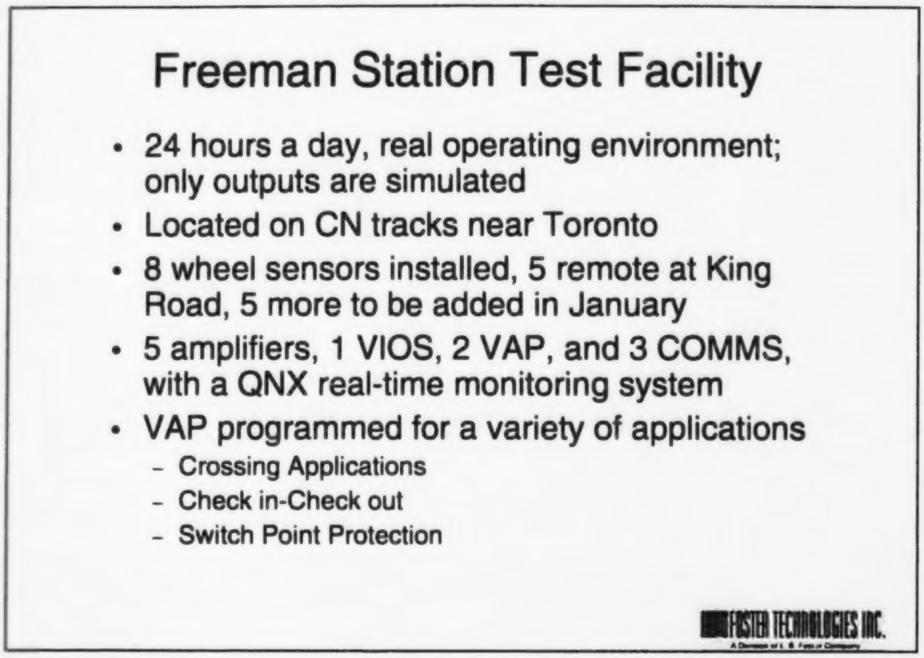

Freeman Station Test Facility

- 24 hours a day, real operating environment; only outputs are simulated
- Located on CN tracks near Toronto
- 8 wheel sensors installed, 5 remote at King Road, 5 more to be added in January
- 5 amplifiers, 1 VIOS, 2 VAP, and 3 COMMS, with a QNX real-time monitoring system
- VAP programmed for a variety of applications
  - Crossing Applications
  - Check in-Check out
  - Switch Point Protection

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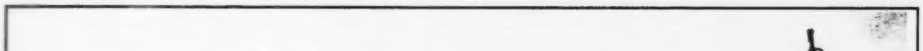

Conclusion

- Wheel counters are an effective and proven detection system for rail-road crossing control systems
- The low cost and ease of installation makes them ideal alternatives to track circuits, especially in challenging locations and dark territory
- Accepted in Europe for many years as vital
- Prototype system in use with CN for over 3 years shows the potential
- New products and systems undergoing extensive field and lab testing prior to external certification and release into the marketplace

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Open Forum Discussion

A lively open forum discussion followed the presentations. Participants agreed that this part of the workshop provided an excellent opportunity for all stakeholders to discuss the status of the various projects within the Rail-Highway Grade Crossing Research Program and any related concerns, as well as to debate current grade crossing issues.

The following outlines the comments, suggestions, and recommendations made during the discussion:

- Research on all projects within the Rail-Highway Grade Crossing Research Program is done in collaboration with the various stakeholders. The first objective is to ensure that all grade crossing research under the program reflects the concerns of regulators, rail carriers, and other stakeholders. The second is to provide all stakeholders with a forum that allows them to communicate and to work together on all grade crossing issues and to accelerate the implementation of new technology and improvements.

- Stakeholders requested TDC to keep them informed on the progress of each research project being developed and implemented.

- Participants were reminded that locomotive engineers are under tremendous stress as they move at relatively high speeds across grade crossings and that locomotive engineers and train crews are often the forgotten victims in grade crossing accidents.

- The importance of research on human behaviour related to grade crossings was stressed, because most grade crossing accidents are a result of human error. It was noted that some of these human factors could be addressed more effectively through the participation of organizations concerned with educating motorists and truck drivers (e.g., the Canadian Trucking Association).

- Participants were informed that although pedestrians and cyclists violate grade crossing rules more often than motorists do, most of the current technology is directed at drivers. In addition, most grade crossing installations, such as lights, are meant for drivers and are not always easily seen by pedestrians and cyclists. All agreed that more should be done to develop technology aimed at pedestrians and cyclists, particularly in urban areas.

Plénière

Les présentations ont été suivies d'une plénière qui a donné lieu à des échanges animés. Pour les participants, cette partie de l'atelier était une excellente occasion de discuter de l'état d'avancement de divers projets inscrits au Programme de recherche sur les passages à niveau ainsi que de leurs préoccupations, et de débattre des questions du jour touchant les passages à niveau.

Voici les commentaires, suggestions, et recommandations formulés au cours de la discussion :

- Tous les projets réalisés dans le cadre du Programme de recherche sur les passages à niveau font appel à la collaboration de plusieurs partenaires. Le premier objectif est de veiller à ce que toute la recherche sur les passages à niveau chapeautée par le programme soit en prise directe avec les préoccupations des organismes de réglementation, des transporteurs ferroviaires et des autres intervenants. Le deuxième objectif est de fournir à tous les intervenants un lieu d'échange où ils puissent communiquer et travailler ensemble sur toutes les questions touchant les passages à niveau et accélérer la mise en oeuvre de nouveaux dispositifs et perfectionnements.

- Les intervenants demandent au CDT de les tenir informés de l'avancement de chacun des projets de recherche élaboré et mis en oeuvre.

- Il est rappelé aux participants que les mécaniciens de locomotive sont sujets à un stress immense lorsqu'ils franchissent, à une vitesse relativement élevée, les passages à niveau, et que les mécaniciens de locomotive et les équipes de train sont souvent les victimes oubliées des accidents aux passages à niveau.

- On insiste sur l'importance de la recherche sur le comportement humain aux passages à niveau, car la plupart de ces accidents sont le résultat d'une erreur humaine. On fait remarquer que l'étude de certains facteurs humains pourrait être facilitée si on sollicitait la participation d'organismes qui s'occupent de la formation des automobilistes et des camionneurs (p. ex., l'Association canadienne du camionnage).

- On fait remarquer aux participants que les piétons et les cyclistes violent les règles relatives aux passages à niveau plus souvent que les automobilistes, mais que la plupart des dispositifs existants visent les conducteurs. De plus, la plupart des installations aux passages à niveau, notamment les feux de signalisation, sont conçues pour les conducteurs et ne sont pas toujours facilement perçues par les piétons et les cyclistes. Tous conviennent qu'il faut faire plus pour mettre au point des dispositifs destinés aux piétons et aux cyclistes, particulièrement en zone urbaine.

Conclusion

Bob Nash of Canadian Pacific Railways closed the workshop. He noted that rail carriers are very pleased with the progress of grade crossing research to date and that they are committed to using the research findings to make changes that will improve safety at grade crossings. He concluded by saying how pleased he was with the large turnout and thanked all participants for their input.

Bob Nash, de Canadien Pacifique Limitée, met un terme à l'atelier. Il fait remarquer que les transporteurs ferroviaires sont très fiers des progrès réalisés à ce jour dans la recherche sur les passages à niveau. Il ajoute que le CP s'est engagé à utiliser les résultats de la recherche pour apporter des changements qui rendront les passages à niveau plus sûrs. Il conclut en se réjouissant de la forte participation à l'atelier et en remerciant toutes les personnes présentes de leur précieuse contribution.

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